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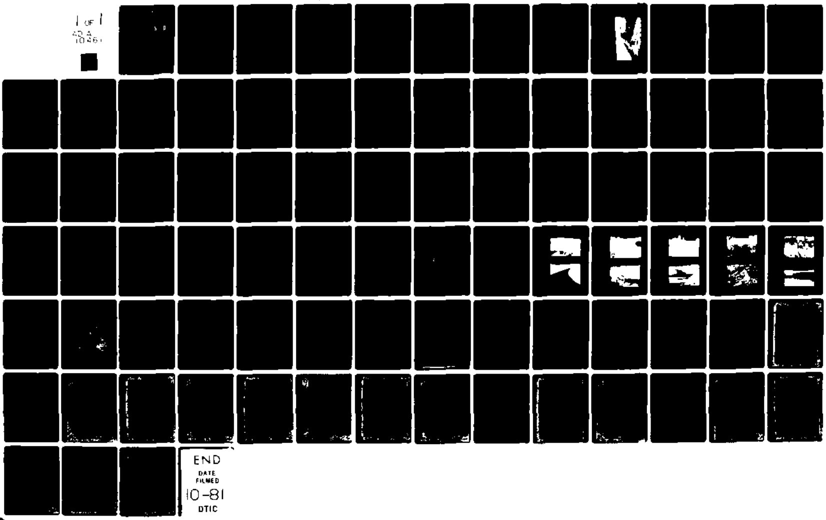

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SPRING LAKE DAM
ADAIR COUNTY, MISSOURI
MO. 10136

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
Serving the Army
Serving the Nation

St. Louis District

PREPARED BY: U. S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

DECEMBER 1979

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This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Spring Lake Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Spring Lake Dam.

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

1) Spillway will not pass 50 percent of the Probable Maximum Flood
2) Overtopping could result in dam failure
3) Dam failure significantly increases the hazard to loss of life downstream

SUBMITTED BY: SIGNED — Chief, Engineering Division — 31 MAR 1980 Date

APPROVED BY: SIGNED — Colonel, CE, District Engineer — 1 APR 1980 Date

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SPRING LAKE DAM

ADAIR COUNTY, MISSOURI

MISSOURI INVENTORY NO. 10136

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

PREPARED BY

CONSOER, TOWNSEND AND ASSOCIATES, LTD.

ST. LOUIS, MISSOURI

AND

ENGINEERING CONSULTANTS, INC.

ENGLEWOOD, COLORADO

A JOINT VENTURE

UNDER DIRECTION OF

ST. LOUIS DISTRICT, CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

DECEMBER 1979

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Spring Lake Dam, Missouri Inv. No. 10136
State Located:	Missouri
County Located:	Adair
Stream:	Elm Creek
Date of Inspection:	August 22, 1979

Assessment of General Condition

Spring Lake Dam was inspected by the engineering firms of Consoer, Townsend and Associates, Ltd. and Engineering Consultants, Inc. (A Joint Venture) of St. Louis, Missouri according to the "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed by the Chief of Engineers, U.S. Army, Washington, D.C., with the help of Federal and State agencies, professional engineering organizations, and private engineers. The resulting guidelines are considered to represent a consensus of the engineering profession.

Based upon the criteria in the guidelines, the dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur in the event of failure of the dam. The estimated damage zone extends approximately five miles downstream of the dam. Within the damage zone are the communities of Yarrow and Gifford and a dwelling and building along Chariton River between the two communities which may

be subjected to flooding, with possible damage and/or destruction and possible loss of life. Spring Lake Dam is in the intermediate size classification since it is less than 40 feet high but impounds more than 1,000 acre-feet of water.

Our inspection and evaluation indicates that the spillway of Spring Lake Dam does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. Spring Lake Dam being an intermediate size dam with a high hazard potential is required by the guidelines to pass the Probable Maximum Flood without overtopping. It was determined that the reservoir/spillway system can accommodate 24 percent of the Probable Maximum Flood without overtopping the dam. Our evaluation also indicates that the reservoir/spillway system can accommodate the 100-year flood without overtopping.

The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in the region. The 100-year flood is defined as a flood having a one percent chance of being equalled or exceeded during any given year.

Other deficiencies noted by the inspection were: the trees and cattails in the spillway; the small trees on the downstream slope; the erosion due to wave action on the upstream slope; the depression at the toe of the dam created by the discharge through the outlet works; the erosion on the left side of the downstream channel; a need for periodic inspection by a qualified engineer and a lack of maintenance schedule. The lack of seepage and stability analyses on record is also a deficiency that should be corrected.

It is recommended that the owner take action to correct or control the deficiencies described above.

Walter G. Shifrin, P.E.

STATE OF MISSOURI
WALTER
G SHIFRIN
NUMBER
E-8834
REGISTERED PROFESSIONAL ENGINEER

Overview of Spring Lake Dam

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

SPRING LAKE DAM, I.D. No. 10136

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

SPRING LAKE DAM, Missouri Inv. No. 10136

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

The Dam Inspection Act, Public Law 92-367 of August, 1972, authorizes the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspections. Inspection for Spring Lake Dam was carried out under Contract DACW 43-79-C-0075 between the Department of the Army, St. Louis District, Corps of Engineers, and the engineering firms of Consoer, Townsend & Associates, Ltd., and Engineering Consultants, Inc. (A Joint Venture), of St. Louis, Missouri.

b. Purpose of Inspection

The visual inspection of Spring Lake Dam was made on August 22, 1979. The purpose of the inspection was to make a general assessment as to the structural integrity and operational adequacy of the dam embankment and its appurtenant structures.

c. Scope of Report

This report summarizes available pertinent data relating to the project, presents a summary of visual observations made during the field inspection, presents an assessment of hydrologic and hydraulic conditions at the site, presents an assessment as to the structural adequacy of the various project features and assesses the general condition of the dam with respect to safety.

Subsurface investigations, laboratory testing and detailed analyses were not within the scope of this study. No warranty as to the absolute safety of the project features is implied by the conclusions presented in this report.

It should be noted that in this report reference to left or right abutments is as viewed looking downstream. Where left abutment or left side of the dam is used in this report, this also refers to the south abutment or side, and right to the north abutment or side.

d. Evaluation Criteria

Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in the publication "Recommended Guidelines for Safety Inspection of Dams," Appendix D. These guidelines were developed with the help of several federal agencies and many state agencies, professional engineering organizations and private engineers.

1.2 Description of the Project

a. Description of Dam and Appurtenances

It should be noted that a trustee of the dam, Mr. Ralph Shane of Kirksville, Missouri, has indicated he has a set of plans pertaining to Spring Lake Dam. However, Mr. Shane has not been able to locate the plans for use in this report. The following description of the dam and appurtenant structures is based exclusively upon observations and measurements made during the visual inspection.

The dam is an earthfill structure. The crest of the embankment has a width of 27 feet and length of approximately 863 feet. The crest elevation is approximately 772 feet above MSL, and the maximum height of the embankment is 25 feet.

The upstream slope of the embankment is protected by riprap and is nearly vertical from the crest to the water surface. The downstream slope was measured as 1V to 2.5H from the crest to the toe of the dam.

The spillway for Spring Lake Dam is a cut into the right abutment. The spillway is a trapezoidal shaped, uncontrolled open channel. The control section has a bottom width of 87 feet and is 4.5 feet high to the top of the dam. The sides of the channel are sloped at 1V to 1H. The spillway channel is approximately 100 feet in length. A concrete slab is provided on the control section of the spillway.

A low-level drain was provided for Spring Lake Dam. The drain consists of two 12-inch diameter cast iron pipes. Each pipe is controlled by a separate gate valve. Both of the valves are located in a valve house at the toe of the dam approximately 20 feet upstream from the downstream end of the pipes. The drain pipes are located approximately 150 feet to the right of the left abutment. The ends of the pipes are approximately 6 feet apart.

b. Location

Spring Lake Dam is located on Elm Creek approximately 0.4 miles upstream from the confluence of Elm Creek and the Chariton River. The community of Yarrow is approximately 0.5 miles to the south of the damsite. The dam is located in the Section 10, Township 61 North, Range 16 West on the Kirksville, Missouri, Quadrangle Sheet (15 minute series).

c. Size Classification

According to the "Recommended Guidelines for Safety Inspection of Dams" by the U.S. Department of the Army, Office of the Chief Engineer, the dam is classified in the dam-size category as being "Intermediate" since its storage is more than 1,000 acre-feet but less than 50,000 acre-feet. The dam is classified as "Small" in the dam-size category because its height is less than 40 feet. The overall size classification is "Intermediate" in size.

d. Hazard Classification

The dam has been classified as having a "High" hazard potential in the National Inventory of Dams, on the basis that in the event of failure of the dam or its appurtenances, excessive damage could occur to downstream property, together with the possibility of the loss of life. Our findings concur with the classification. Within the estimated damage zone, which extends approximately five miles downstream of the dam, are the two small communities of Yarrow and Gifford, and a dwelling and building along the Chariton River between the two communities.

e. Ownership

The Spring Lake Dam is owned privately by Spring Lake, Inc. The mailing address is Spring Lake, Inc., c/o James M. Rolston, Box 190, Kirksville, Missouri 63501.

f. Purpose of Dam

The main purpose of the dam is to impound water for recreational use.

g. Design and Construction History

Spring Lake Dam was designed by J.W. Shikles and Company, Kansas City, Missouri, in 1947-48.

Originally, and up until three years ago, according to Mr. James Rolston, a trustee of Spring Lake, the primary purpose of the dam was for domestic water storage. Since 1976, the lake has been used primarily for recreational purposes.

h. Normal Operational Procedures

Normal procedure is to allow the lake to remain as full as possible. The water level below the spillway crest is controlled by rainfall, runoff and evaporation. The reservoir is equipped with a low-level outlet, but according to Mr. James Rolston, a trustee of Spring Lake, the valves to the drain system have not been operated in the last six or seven years.

1.3 Pertinent Data

a. Drainage Area (square miles): 2.88

b. Discharge at Damsite

Estimated experienced maximum flood (cfs):	NA
Estimated ungated spillway capacity with reservoir at top of dam elevation (cfs)	2,650

c. Elevation (feet above MSL)

Top of dam:	772
Spillway crest:	767.5
Normal Pool:	767.5
Maximum Pool (PMF):	775.43

d. Reservoir

Length of pool with water surface at top of dam elevation (feet):	4,170

e. Storage (Acre-Feet)

Top of dam:	1,078
Spillway crest:	740
Normal Pool:	740
Maximum Pool (PMF):	1,429

f. Reservoir Surfaces (Acres)

Top of dam:	84
Spillway crest:	70.5
Normal Pool:	70.5
Maximum Pool (PMF):	118

g. Dam

Type:	Earthfill

Length:	863 feet
Structural Height:	25 feet
Hydraulic Height:	25 feet
Top width:	27 feet
Side slopes:	
Downstream	1V to 2.5H
Upstream	Near Vertical (crest to water surface
Zoning:	Unknown
Impervious core:	Unknown
Cutoff:	Unknown
Grout curtain:	Unknown

h. Diversion and Regulating Tunnel None

i. Spillway

Type:	Trapezoidal open channel, uncontrolled
Length of crest:	87 feet
Crest Elevation (feet above MSL):	767.5

j. Regulating Outlets

Type:	Two, 12-inch diameter low-level drains
Length:	Unknown
Closure:	Two gate valves
Maximum Capacity:	Unknown

SECTION 2: ENGINEERING DATA

2.1 Design

A trustee of the dam, Mr. Ralph Shane of Kirksville, Missouri, has indicated that he has a complete set of plans pertaining to Spring Lake Dam; however, he has not been able to locate the plans for use in this report.

2.2 Construction

No construction data are available for the dam and appurtenant structures. In addition, no data were available regarding the reconstruction to control seepage near the left abutment.

2.3 Operation

No operation records are available for Spring Lake Dam.

2.4 Evaluation

a. Availability

The availability of engineering data is poor and consists only of state geological maps and U.S.G.S. quadrangle sheets. No information on design hydrology or hydraulic design was available.

b. Adequacy

The lack of engineering data did not allow for a definitive review and evaluation. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing and evaluating design, operation and construction data, but is based primarily upon visual inspection, past performance history and sound engineering judgment.

Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions including Earthquake Loads and made a matter of record.

c. Validity

No valid engineering data are available.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

A visual inspection of the Spring Lake Dam was made on August 22, 1979. The dam generally is in satisfactory condition. The following persons were present during the inspection:

Name	Affiliation	Disciplines
Dr. M.A. Samad	Engineering Consultants, Inc.	Project Engineer, Hydraulics and Hydrology
Mark R. Haynes	Engineering Consultants, Inc.	Civil, Structural and Mechanical
Dawn L. Jacoby	Engineering Consultants, Inc.	Soils
Peter L. Strauss	Engineering Consultants, Inc.	Geology
Kevin Blume	Consoer, Townsend & Assoc., Ltd.	Civil and Structural
Jim Rolston	Spring Lake, Inc.	Board Member

Specific observations are discussed below.

b. Dam

The crest of the dam supports a well-maintained gravel road with cut grass on each side. No deviations in horizontal or vertical alignment were apparent. No settlements or bulges were observed. To the best of Mr. Rolston's knowledge, the dam has never been overtopped and there was no evidence indicating the contrary.

The upstream slope was protected partially from erosion by riprap with a maximum size of 36 inches. The upper section of the slope was covered by grass and bushes. Some erosion due to wave action is occurring above the riprap, which has steepened the slope above the riprap to near vertical. No bulges or depressions were observed. There was no evidence of rodent activity.

The downstream slope is covered by grass and weeds. Several small trees are growing along the slope. No bulges or depressions were observed. No cracks or signs of instability were apparent. No seepage was observed on the slope or downstream of the toe.

No data are available indicating the type of material used for construction of the embankment. Material taken from below the topsoil on the embankment was a silty clay.

According to the "Missouri General Soil Map and Soil Association Description" published by the Soil Conservation Service, the materials in the general area of the dam belong to the soil series of Weller-Keswick-Lindley-Mandeville in the Central Mississippi Valley Wooded Slopes forest. These soils are formed basically from loess, glacial till and

weathered shale. The permeability of these soils range from slow to moderate and erodability is quite high.

c. Project Geology

The damsite physiographically is located in the Dissected Till Plains Section of the central lowlands Physiographic Province, according to Nevin Fenneman's "Physiography of the Eastern United States." This section is distinguished from the Till Plains on the east and from the Young Drift section on the north by the stage it has reached in the post-glacial erosion cycle. Broadly generalized, this section is a nearly flat till plain, submature in its erosion cycle.

No faults have been identified in the project vicinity.

Approximately 12 miles to the southwest of the damsite lies the trace of the Macon-Sullivan Trough that had its last movement in post-Ordovician time. This minor structure has no effect on the dam.

The site bedrock geology, beneath the drift, as shown on the Geologic Map of Missouri (1979), is interbedded Pennsylvanian age shales, limestones and sandstones. These strata generally strike north-south and dip gently to the west.

The left abutment of the dam is in contact with thin tightly bedded, gray fossiliferous limestone. This rock was hard, dense and stable.

A small drainage creek runs behind the left abutment and below the toe of the dam. This small creek is well channelized in rock behind the left abutment.

The downstream channel contains interbedded sandstones, limestones and calcareous shales. The bedding is nearly horizontal but somewhat undulatory. A sandstone cap about 2.5 feet thick overlies about 6 feet of argillaceous limestone/sandstone. The upper four feet of the limestone is fissile and soft. The lower two feet contain somewhat more sand and are micaceous. These lower two feet could be classified as an argillaceous sandstone.

The downstream channel appeared to be man made. A number of large sandstone pieces from the cap are lying in the channel as a result of being undermined by the eroding fissile limestone. The channel appears to be relatively stable.

From the surrounding evidence, it is assumed the dam is founded on bedrock.

d. Appurtenant Structures

(1) Spillway

The spillway is an excavated channel on the right abutment. The channel is excavated to bedrock. The spillway is obstructed by cattails and a few trees. The right side slope of the spillway channel appears to be stable and is adequately protected from surface erosion by a heavy grass cover. The left side slope is a constructed berm that channelizes discharges through the spillway away from the downstream slope of the embankment. The slope is protected by rock masonry and appears to be stable.

The road along the dam crest passes across the spillway channel. The road comes down the crest near the right abutment, passes through the spillway and then goes up the right abutment. A portion of the road is a concrete slab, 18 feet wide and 122 feet long, placed in the spillway channel. The slab appeared to be stable, however, a few temperature cracks were observed.

(2) Outlet Works

The outlet works for Spring Lake Dam consists of two 12-inch cast iron low-level drain pipes. The discharge through the pipes is controlled by individual gate valves located in a valve house at the toe of the dam. It is unknown whether the valves are operable. The valves were inaccessible for manual operation on the day of the inspection due to a locked door. The intake of the drain was inaccessible due to the reservoir level. No seepage was observed in or around the pipes.

Discharges through the pipes have created a depression just downstream of the outlets that has started to undercut the pipes. The last 12 feet of the drain pipes appeared to have been originally 12-inch corrugated metal pipes. It appears that discharges through the pipes must have undercut the two C.M. pipes eventually causing them to collapse. The two C.M. pipes are still lying below the two cast iron pipes.

e. Reservoir Area

The water surface elevation was 767.2 feet above MSL on the day of the inspection.

The reservoir rim is sloped gently and no indication of instability or severe erosion was readily apparent. The slopes above the reservoir are wooded and grass covered. Several homes are built around the reservoir rim.

f. Downstream Channel

The downstream channel of the spillway is a rock cut channel having a bottom width of approximately 15 feet and side slopes of 1V to 0.5H. The channel widens out into a grass-lined channel. The channel is unobstructed. The channel has been eroded on the left side.

3.2 Evaluation

The visual inspection did not reveal any items that are sufficiently significant to indicate a need for immediate remedial action.

The following conditions were observed that could affect the safety of the dam or that will require maintenance within a reasonable period of time.

1. The wave erosion on the upstream slope, if allowed to continue, could affect the structural stability of the dam.

2. The small trees observed on the downstream slope do not jeopardize the safety of the embankment at their present stage of growth. Nevertheless, the trees should be removed from the embankment and not allowed to grow back. As the trees grow larger, the root systems also grow larger thus endangering the safety of the dam. The roots of the trees present possible paths for piping through the embankment. The root system could also damage the dam if a tree is uprooted by a storm.

3. The obstruction created by cattails and trees in the spillway poses a danger to the safety of the embankment. The obstruction decreases the capacity of the spillway, thus increases the potential of overtopping the dam. The cattails and trees should be removed and prevented from growing back.

4. The depression created by discharges through the low-level drain does not appear to affect the safety of the drain or the embankment of the dam in its present condition. Nevertheless, this condition should be monitored and if the erosion continues, steps should be taken to correct the situation.

5. The erosion on the left side in the downstream channel, if allowed to continue, would affect the stability of the side slope of the channel.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

Spring Lake Dam is used to impound water for recreational use. The lake is kept as full as possible at all times. According to Mr. Rolston, a trustee of Spring Lake. the water level does not fluctuate very much throughout the year.

4.2 Maintenance of Dam

The dam is maintained by several local residents and the trustees of Spring Lake Development. The dam crest is kept in exceptionally good condition due to the well-maintained 24-foot wide gravel road. The upstream and downstream slopes are kept fairly cleared of trees and dense vegetation. Mr. Rolston informed the inspection team that the vegetation in the spillway channel usually is cleaned out yearly but was overlooked this year.

4.3 Maintenance of Operating Facilities

The only operable facilities at the damsite consist of the two gate valves located in the valve house at the toe of the dam near the left abutment. Although the valves have not been operated in six or seven years, Mr. Rolston, a trustee, believes that the valves could be operated if needed.

4.4 Description of Any Warning System in Effect

The inspection team is not aware of any existing warning system in effect for this dam.

4.5 Evaluation

Generally speaking, the operation and maintenance for Spring Lake Dam is adequate. To improve the operational adequacy of the dam, the corrective measures outlined in this report should be initiated within a reasonable period of time.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design

The watershed area of the Spring Lake Dam upstream from the dam axis consists of approximately 1,846 acres. Most of the watershed area is wooded and covered with grass. Land gradients in the higher regions of the watershed average roughly 12 percent, and in the lower areas surrounding the reservoir average about 20 percent. Spring Lake Dam Reservoir is located on Elm Creek and the Chariton River. At its longest arm, the watershed is approximately 1.5 miles long. A drainage map showing the watershed area is presented as Plate 1 in Appendix B.

Evaluation of the hydraulic and hydrologic features of Spring Lake Dam was based upon criteria set forth in the Corps of Engineers' "Recommended Guidelines for Safety Inspection of Dams," and additional guidance provided by the St. Louis District of the Corps of Engineers. The Probable Maximum Flood (PMF) was calculated from the Probable Maximum Precipitation (PMP) using the methods outlined in the U.S. Weather Bureau Publication, Hydrometerological Report No. 33. The probable maximum storm duration was set at 24 hours, and storm rainfall distribution was based upon criteria given in the Corps of Engineers' EM 1110-2-1411 (Standard Project Storm). The Soil Conservation Service (SCS) method was used for deriving the unit hydrograph, utilizing the Corps of Engineers' computer program HEC-1 (Dam Safety Version). The unit hydrograph parameters are presented in Appendix B. The

SCS method also was used for determining the loss rate. The hydrologic soil group of the watershed was determined by use of published soil maps. The hydrologic soil group of the watershed and the SCS curve number are presented in Appendix B. The curve number, unit hydrograph parameters, the PMP index rainfall and the percentages for various durations were directly input to the HEC-1 (Dam Safety Version) computer program to obtain the PMF hydrograph. The computed peak inflow of the PMF and one-half of the PMF are 19,737 cfs and 9,868 cfs, respectively.

Both the PMF and one-half of the PMF inflow hydrographs were routed through the reservoir by the Modified Puls Method also utilizing the HEC-1 (Dam Safety Version) computer program. The reservoir was assumed at the spillway crest level at the start of the routing computation. The peak outflow discharges for the PMF and one-half of the PMF are 17,866 and 8,169 cfs, respectively. Both the PMF and one-half of the PMF when routed through the reservoir resulted in overtopping of the dam.

The size of physical features utilized to develop the stage-outflow relation for the spillway and overtopping of the dam were prepared from field notes and sketches prepared during the field inspection. The reservoir stage-capacity data were based upon the U.S.G.S. Kirksville Quadrangle topographic map (15 minute series). The spillway and dam overtop-rating curve and the reservoir-capacity curve are presented as Plates 2 & 3, respectively, as Appendix B.

From the standpoint of dam safety, the hydrologic design of a dam must aim at avoiding overtopping. Overtopping is especially dangerous for an earth dam because of its erodable characteristics. The safe hydrologic design of an

embankment dam requires a spillway discharge capability, in combination with an embankment crest height that can handle a very large and exceedingly rare flood without overtopping.

The Corps of Engineers design dams to safely pass the Probable Maximum Flood that could be generated from the dam's watershed. This generally is the accepted criterion for major dams throughout the world and is the standard for dam safety where overtopping would pose any threat to human life. Accordingly, the hydrologic requirement for safety for this dam is the capability to pass the Probable Maximum Flood without overtopping.

b. Experience Data

It is believed that records of reservoir stage or spillway discharge are not maintained for this site.

c. Visual Observations

Observations made of the spillway during the visual inspection are discussed in Section 3.1c(1) and evaluated in Section 3.2.

d. Overtopping Potential

As indicated in Section 5.1.a, both the Probable Maximum Flood, when routed through the reservoir, resulted in overtopping of the dam. The peak outflow discharges for the PMF and one-half of the PMF are 17,866 and 8,169 cfs, respectively. The maximum capacity of the spillway just before overtopping the dam is 2,650 cfs. The PMF overtopped the dam crest by 3.04 feet and one-half of the PMF overtopped by 1.48 feet. The total duration of embankment overflow is 5.58 hours

during the PMF and 2.83 hours during one-half of the PMF. The spillway/reservoir system of Spring Lake Dam is capable of accommodating a flood equal to approximately 24 percent of the PMF just before overtopping the dam. The reservoir/spillway system of Spring Lake Dam will accommodate the 100-year flood without overtopping.

The failure of the dam could cause extensive damage to the property downstream of the dam and possible loss of life. The estimated damage zone extends approximately five miles downstream of the dam. Within the damage zone are two small communities, Yarrow and Gifford, and a dwelling and building along Chariton River between the two communities.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

There were no major signs of settlement or distress observed on the embankment or foundation during the visual inspection. The crest is well protected by a gravel road. The downstream slope is protected by vegetation. The upstream slope has some riprap protection. The upstream slope is experiencing erosion due to wave action, which has steepened the slope above the water surface to near vertical. This condition is not serious at this time, but it should be monitored and the slope stabilized as required.

Overall, the spillway channel, the downstream channel and the low-level drain appear to be structurally stable. The exception is the erosion observed on the left side of the downstream channel. This erosion should be monitored and remedial measures undertaken as required.

b. Design and Construction Data

No design computations were uncovered during the report preparation phase. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available. No embankment or foundation soil parameters were available for carrying out a conventional stability analysis on the embankment. No construction data or specifications relating to the degree of

embankment compaction were available for use in a stability analysis.

c. Operating Records

No operating records were available relating to the stability of the dam or appurtenant structures. The water level on the day of the inspection was 4 inches below the crest of the spillway, and it is assumed that the reservoir remains close to full at all times.

d. Post Construction Changes

According to Mr. Rolston, prior to 1967, seepage was passing through cracks in the rock of the left abutment and exiting downstream of the dam to the left of the valve house. The reservoir was lowered and a trench was excavated into the abutment. The trench was then backfilled with impervious material, which stopped the seepage. No seepage has occurred since.

No other post construction changes exist that will affect the structural stability of the dam.

e. Seismic Stability

The dam is located in Seismic Zone 1, as defined in "Recommended Guidelines For Safety Inspection of Dams" prepared by the Corps of Engineers, and therefore, does not require a seismic stability analysis.

SECTION 7: ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment

The assessment of the general condition of the dam is based upon available data and visual inspection. Detailed investigations, testing and detailed computational evaluations are beyond the scope of a Phase I investigation, however, the investigation is intended to identify any need for such studies.

It should be realized that the reported condition of the dam is based upon observations of field conditions at the time of inspection along with data available to the inspection team.

It is also important to note that the condition of a dam depends upon numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be assurance that an unsafe condition could be detected.

a. Safety

The spillway capacity of Spring Lake Dam was found to be "Seriously Inadequate". The spillway/reservoir system will accommodate only 24 percent of the PMF without overtopping the dam. The PMF overtopped the dam by over three feet and the duration of embankment overflow is over 5-1/2 hours. If the body of the dam is made up of silty soils, the dam would be susceptible to erosion and failure during overtopping.

No quantitative evaluation of the safety of the embankment can be made in view of the absence of seepage and stability analyses. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions and made a matter of record. The present embankment and appurtenant structures, however, reportedly have performed satisfactorily since their construction without failure or evidence of instability. Reportedly, the dam has never been overtopped and no evidence indicating the contrary was observed.

b. Adequacy of Information

Pertinent information relating to the design of the dam is lacking. The conclusions presented in this report are based upon field measurement, past performance and the present condition of the dam. Information on the design hydrology, hydraulic design, and the operation and maintenance of the dam were not available for review. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Urgency

The remedial measures recommended in Paragraph 7.2 should be accomplished within a reasonable period of time. The items recommended in Paragraph 7.2a should be persued on a high priority basis.

d. Necessity for Phase II Inspection

Based upon results of the Phase I inspection, and if the remedial measures recommended in Paragraph 7.2 are undertaken, a Phase II inspection is not felt to be necessary.

7.2 Remedial Measures

a. Alternatives

Spillway capacity and/or height of the dam should be increased to accommodate the PMF without overtopping the dam.

b. O & M Procedures

1. The trees and cattails in the spillway should be removed and prevented from growing back.

2. The small trees on the downstream slope should be removed and prevented from growing back.

3. Monitor the erosion due to wave action observed on the upstream slope.

4. Monitor the depression created by the discharge at the downstream end of the low-level drain.

5. Monitor the erosion on the left side of the downstream channel.

6. Seepage and stability analyses should be performed by a professional engineer experienced in the design and construction of earth dams.

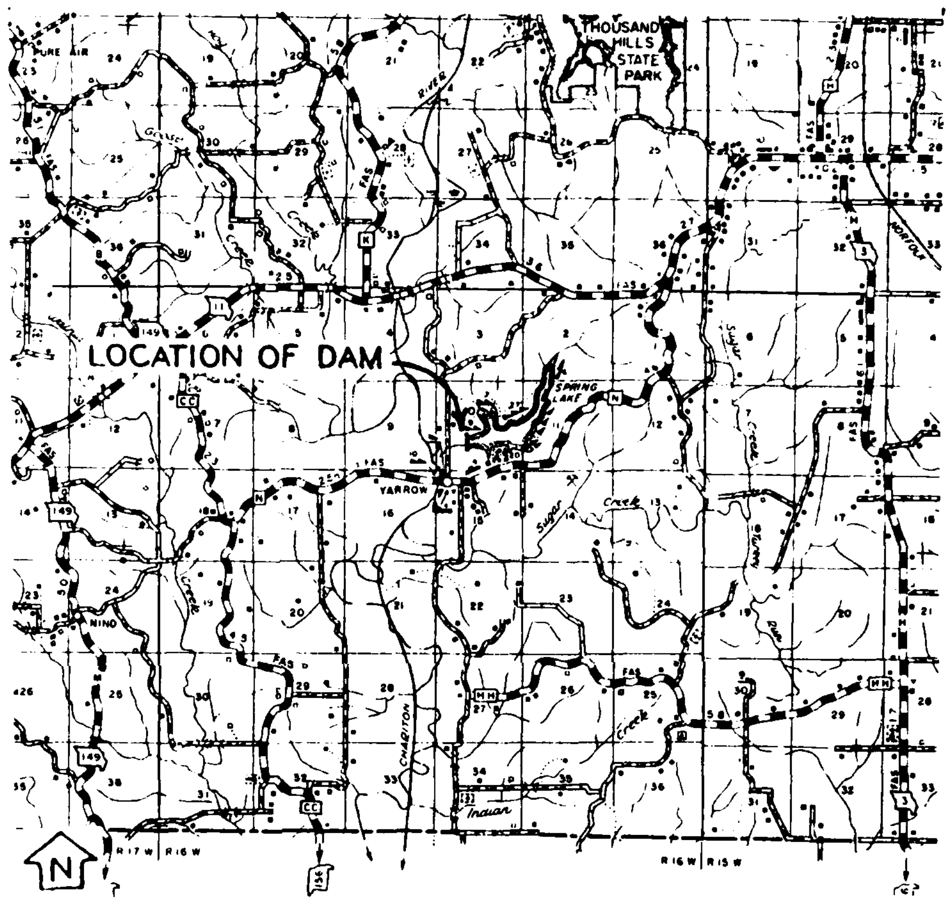
7. The owner should initiate the following programs:

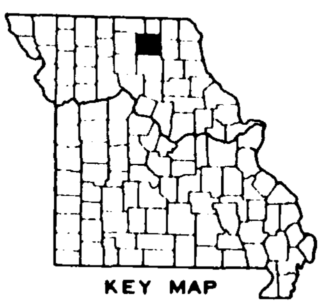
   (a) Periodic inspection of the dam by a professional engineer experienced in the design and construction of earthen dams.

   (b) Set up a maintenance schedule and log all visits to the dam for operation, repairs and maintenance.

PLATES

PLATE I





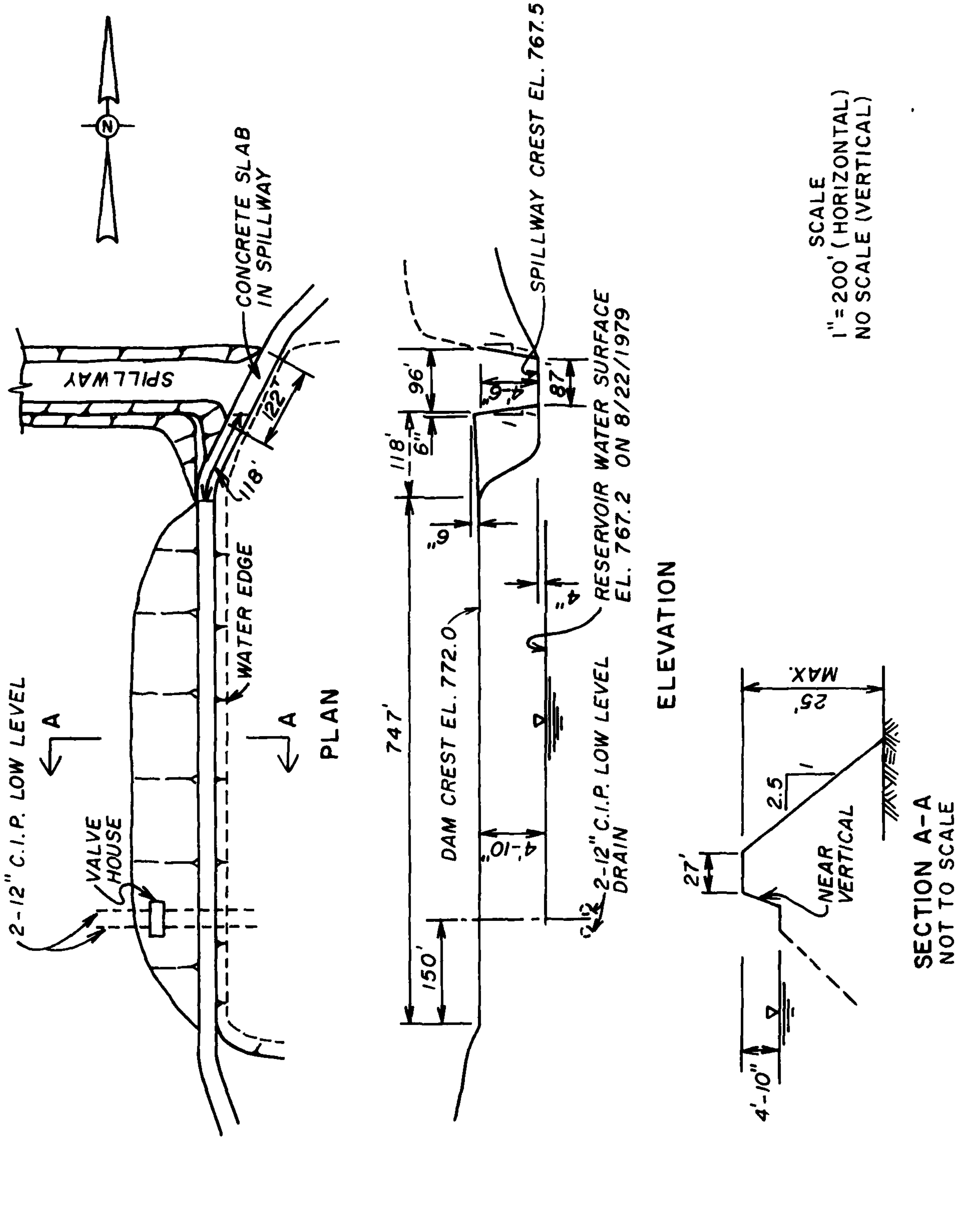
KEY MAP
SHOWING LOCATION OF COUNTY

ADAIR COUNTY

SCALE

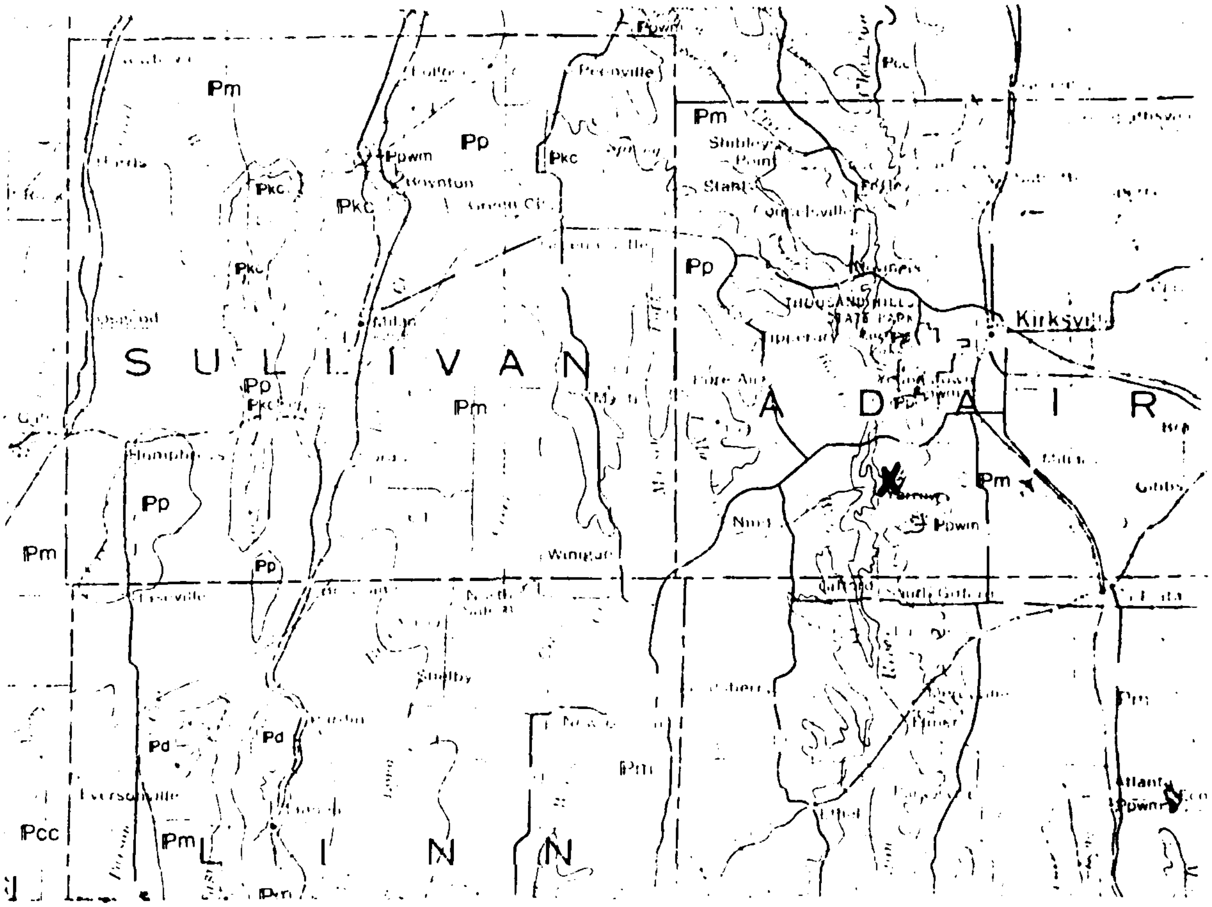
1 0 1 2 3 4 MILES

LOCATION MAP — SPRING LAKE DAM



SPRING LAKE DAM (MO. 10136)
PLAN, ELEVATION & SECTION

PLATE-3



PENNSYLVANIAN
- Ppwm, Pp } PLEASANTON GROUP
- Pm - MARMATON GROUP
- Pcc - CHEROKEE GROUP, CABANISS SUBGROUP

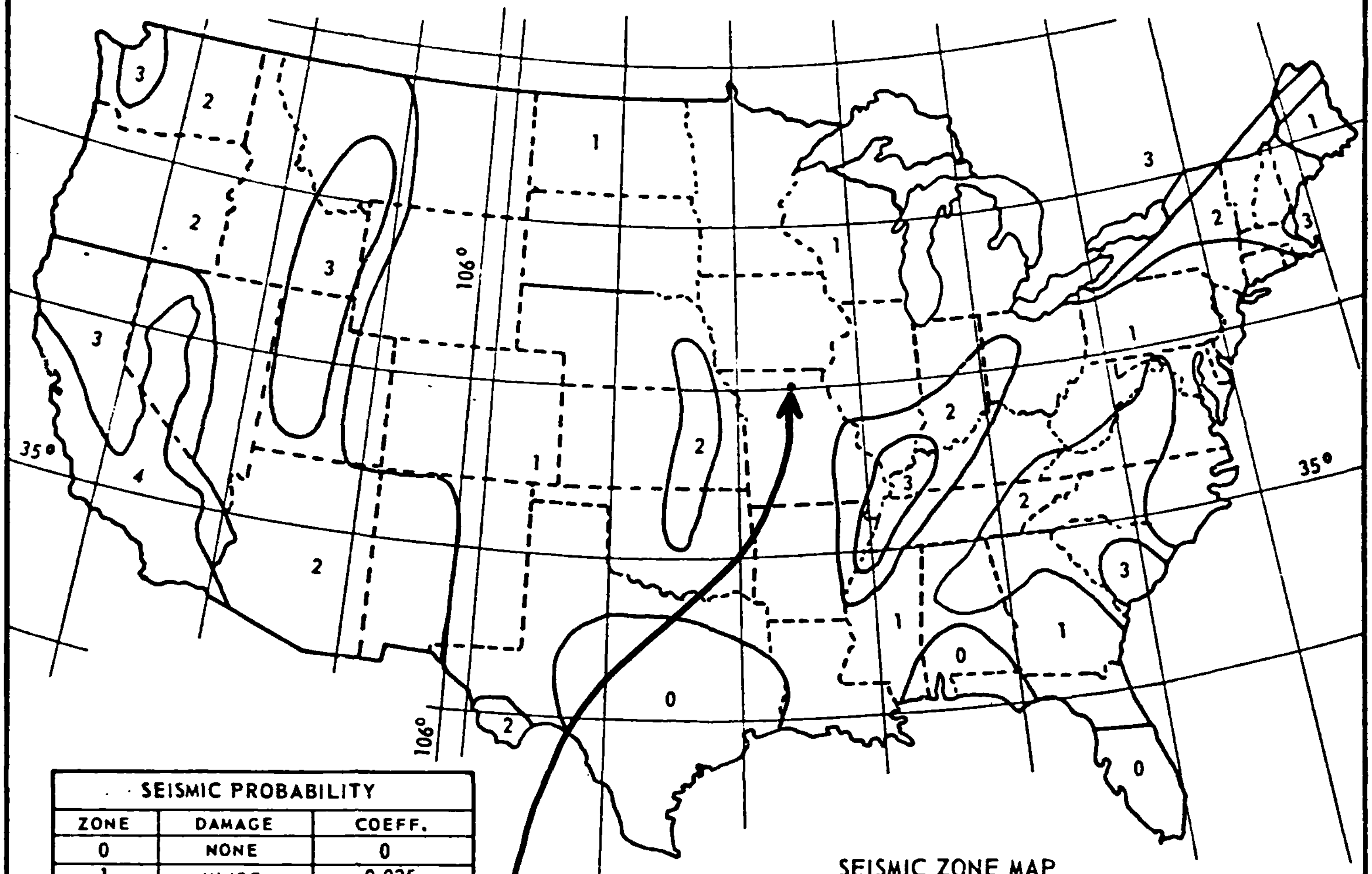
X - LOCATION OF DAM, MO. 10136

REFERENCE:
GEOLOGIC MAP OF MISSOURI
MISSOURI GEOLOGIC SURVEY
1979

GEOLOGIC MAP OF ADAIR COUNTY AND ADJACENT AREA

PLATE-4

From TM 5-809-10 NAVFAC P-355 AFM 88-3, Chapter 13; April 1973



SEISMIC PROBABILITY		
ZONE	DAMAGE	COEFF.
0	NONE	0
1	MINOR	0.025
2	MODERATE	0.05
3	MAJOR	0.10
4	GREAT	0.15

SEISMIC ZONE MAP
of
CONTIGUOUS STATES

Approximately location of Spring Lake Dam.

APPENDIX A

PHOTOGRAPHS TAKEN DURING INSPECTION

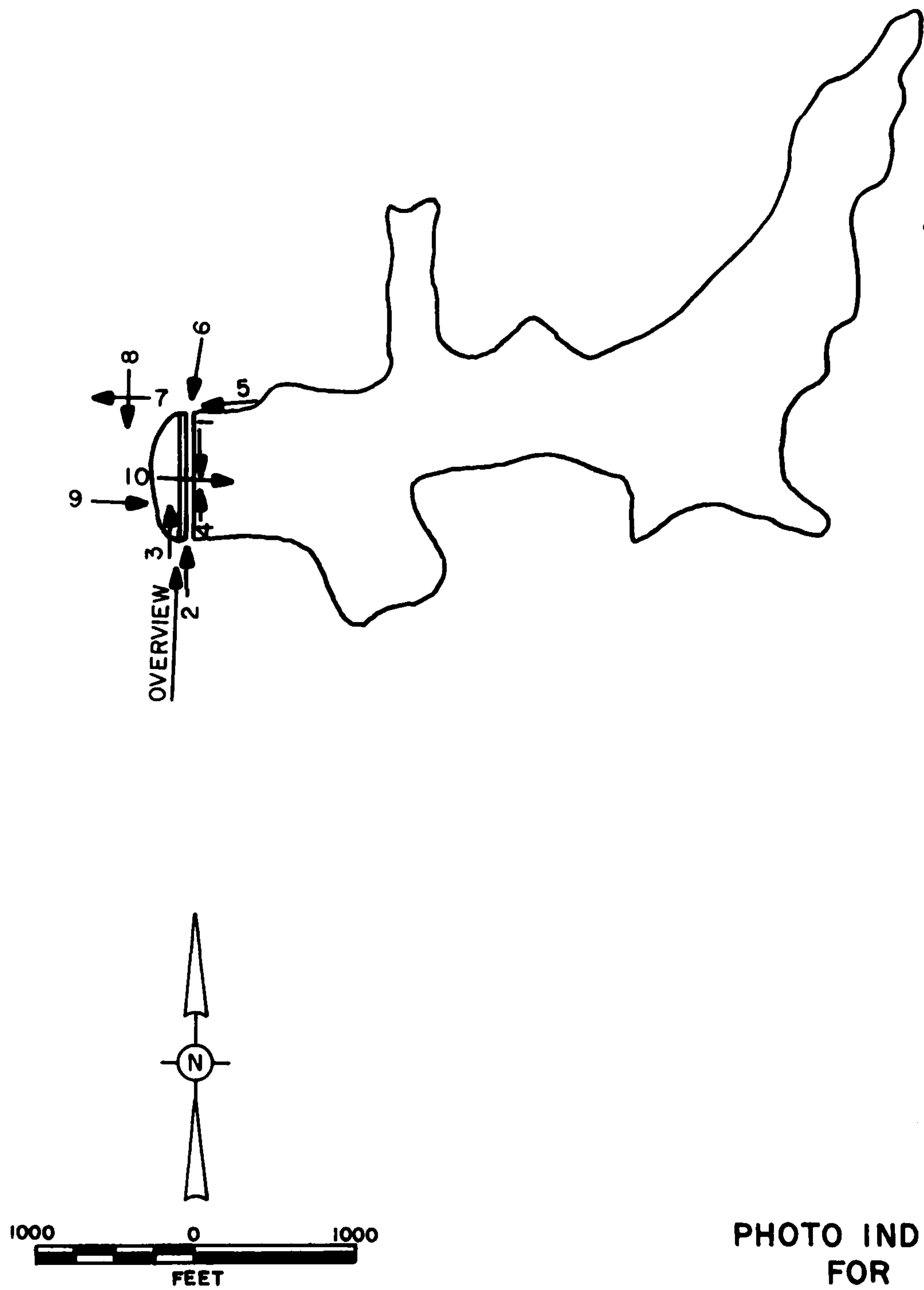


PHOTO INDEX
FOR
SPRING LAKE DAM

Spring Lake Dam

Photo 1.	-	View of the upstream slope of the embankment.
Photo 2.	-	View of the crest.
Photo 3.	-	View of the downstream slope of the embankment.
Photo 4.	-	Closeup view of the riprap on the upstream slope.
Photo 5.	-	View of the spillway from upstream.
Photo 6.	-	View of the road through the spillway just upstream of the control section.
Photo 7.	-	View of the downstream channel.
Photo 8.	-	View of the stratification of the bedrock in the downstream channel.
Photo 9.	-	View of the outlet of the low level drain. Note the valve house in the background.
Photo 10.	-	View of the reservoir rim.

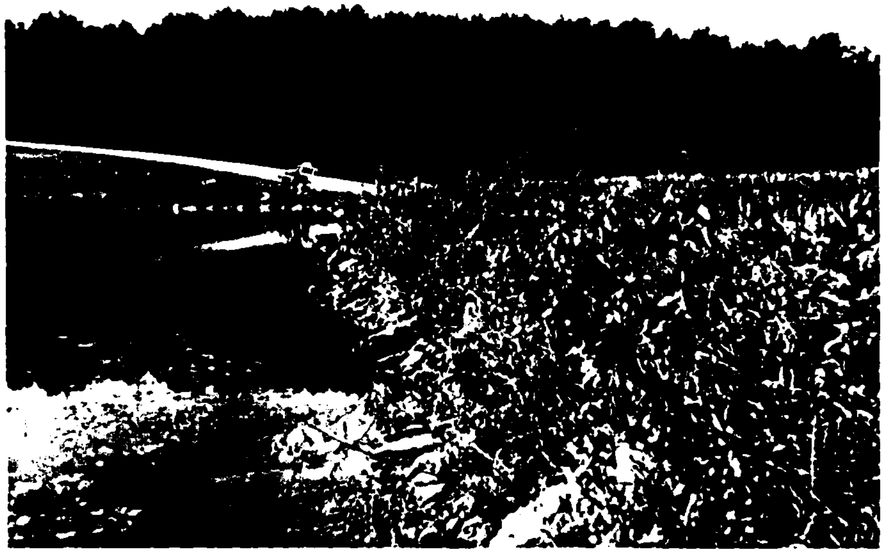


Photo 1

Photo 2

Photo 3

Photo 4

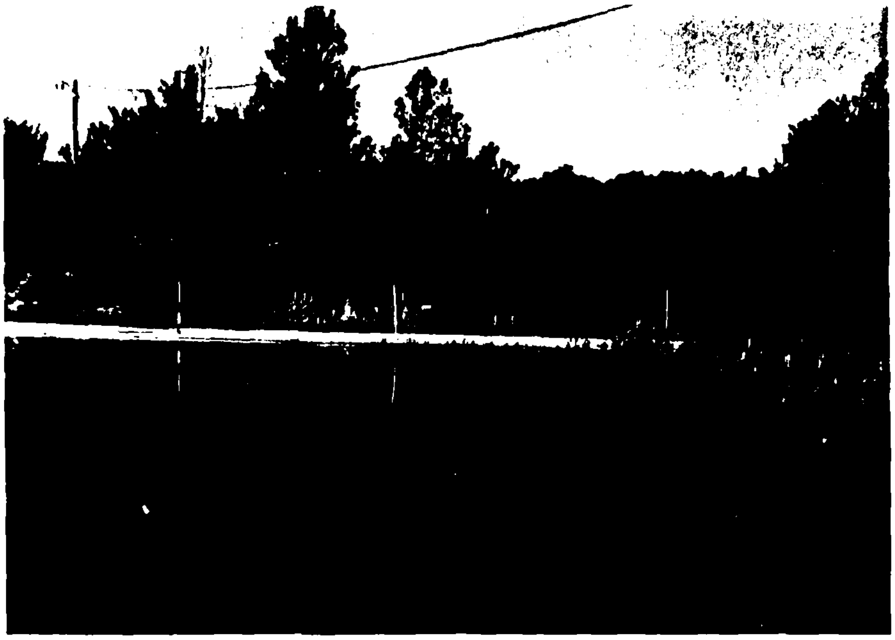


Photo 5

Photo 6

Photo 7

Photo 8

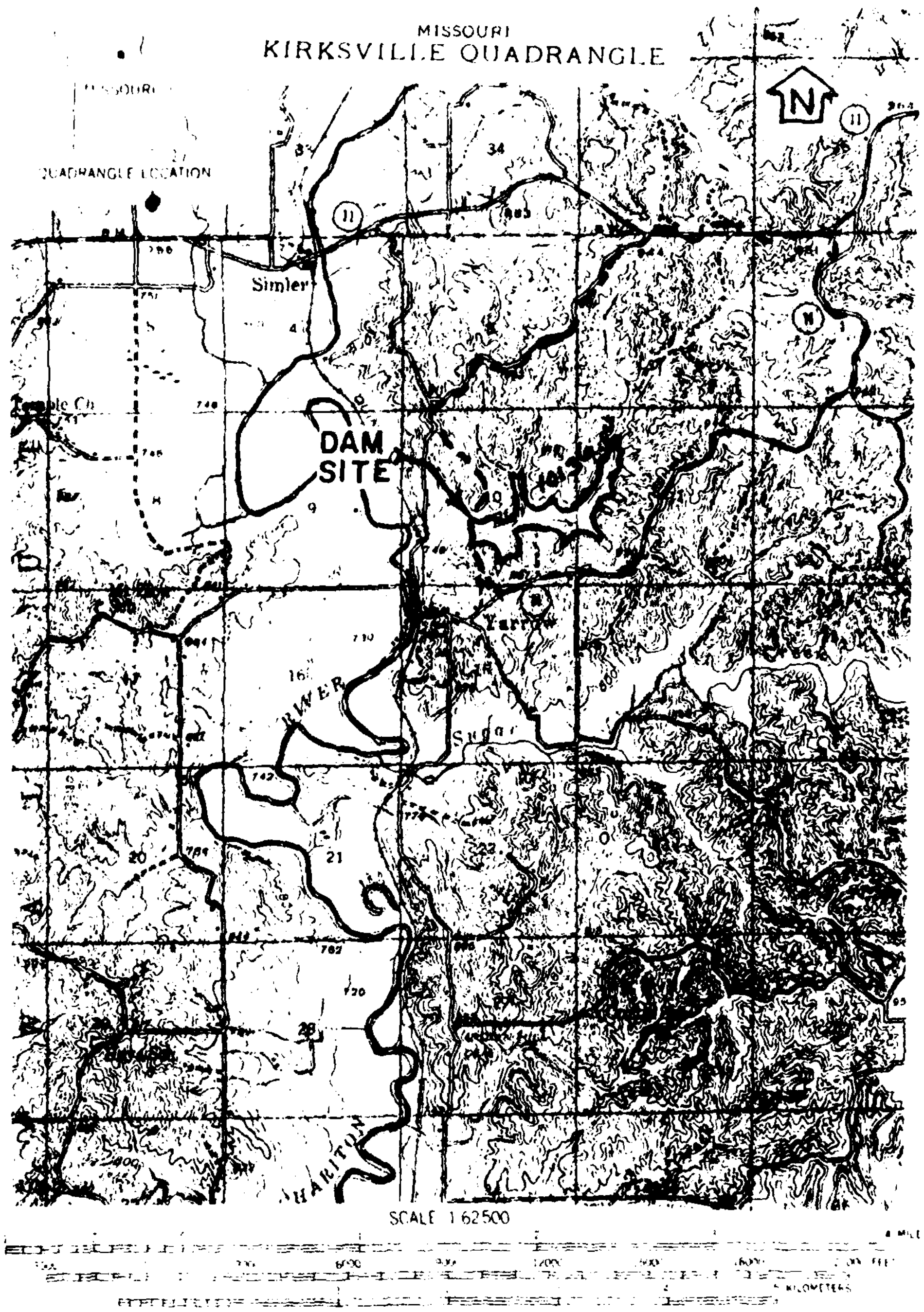
Photo 9

Photo 10

APPENDIX B

HYDROLOGIC COMPUTATIONS

PLATE I, APPENDIX B



DRAINAGE BOUNDARY — — — — —

SPRING LAKE DAM
(MO 10136)

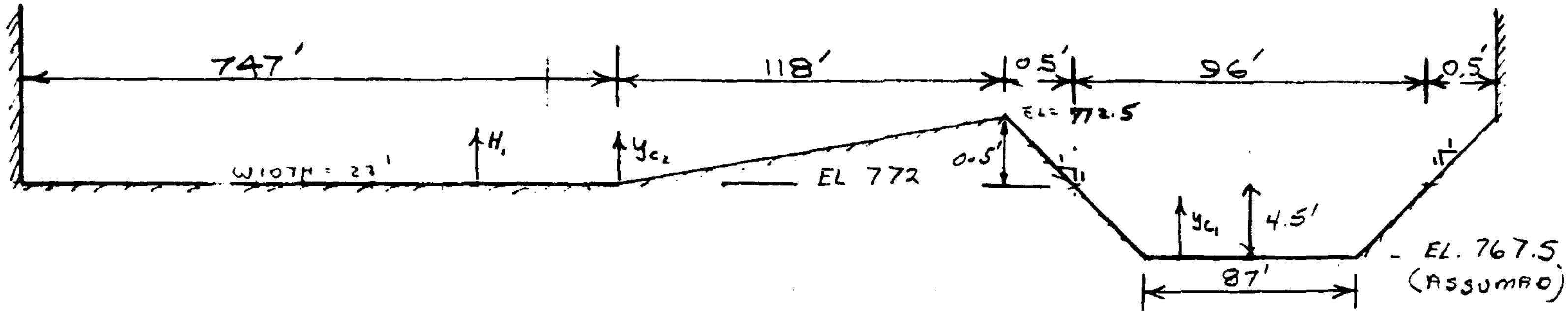
DRAINAGE BASIN

PRC, ENGINEERING CONSULTANTS, INC.

DAM SAFETY INSPECTION / MISSOURI — SHEET NO. 1 OF ___

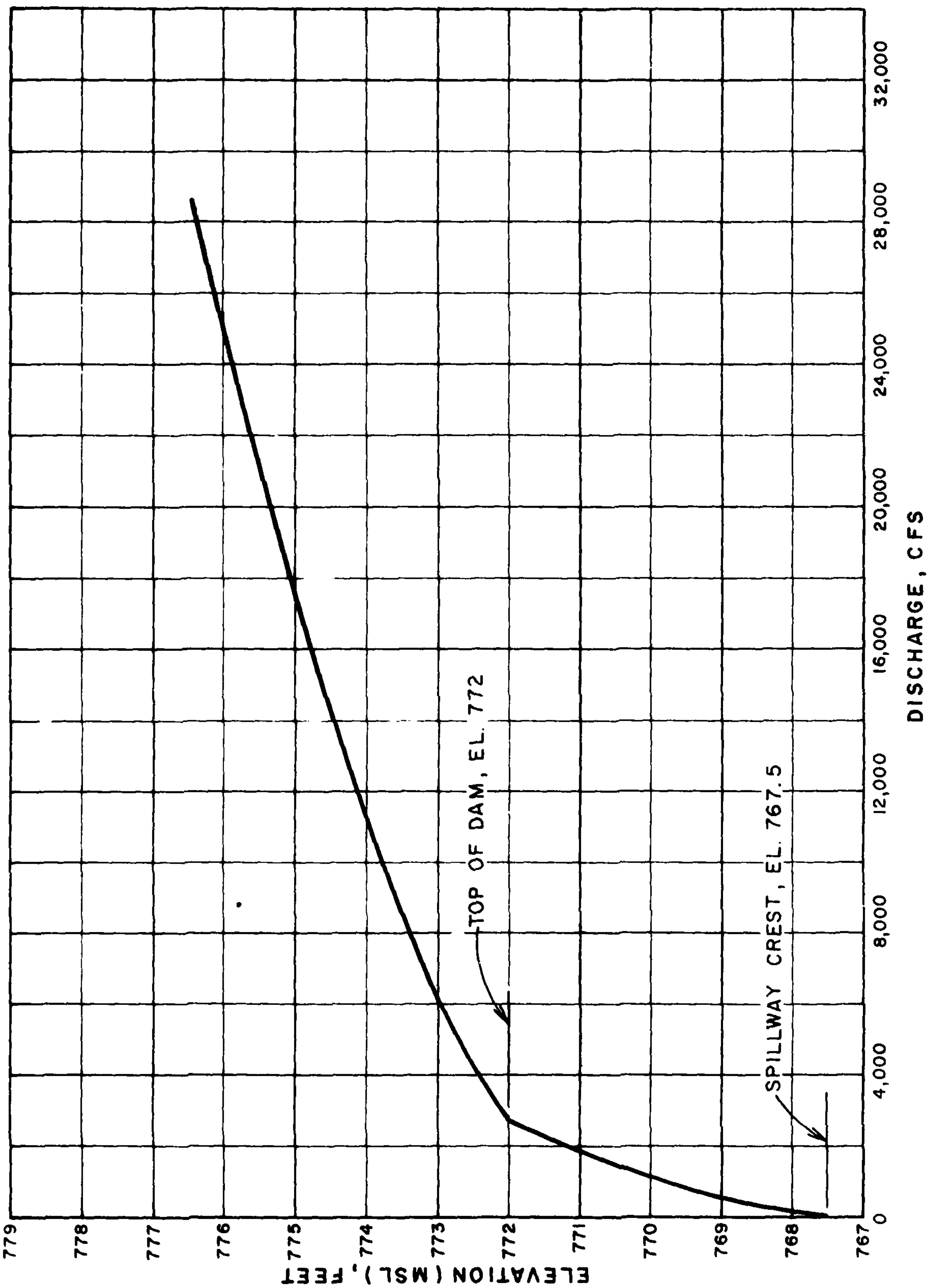
SPRING LAKE DAM (MO. 10136) — JOB NO. 1240-001

SPILLWAY & OVERTOP RATING CURVE — BY RRW / HLB — DATE ___



y_{c_1}	T_{c_1}	A_{c_1}	$V_{c_1}=5.67\sqrt{A/T}$	$Q_1=V_{c_1}A_{c_1}$	U/S W.S. $= y_c+V^2/2g+767.5$	$y_{c_2}=2/3\times$ (W.S. -772)	T_{c_2}	A_{c_2}	V_{c_2}	Q_{c_2}	H_1	L_1	C_1	$Q_1=L_1C_1H_1^{3/2}$	$Q_T=Q_c+Q_{c_2}+Q_1$
0	-	-	-	-	767.5	-	-	-	-	-	-	-	-	-	0
1	89	88	5.64	496	768.99	-	-	-	-	-	-	-	-	-	496
2	91	178	7.93	1411	770.48	-	-	-	-	-	-	-	-	-	1411
3	93	270	9.66	2608	771.95										2608
4	95	364	11.10	4040	773.4	0.9	118	81.42	4.71	383	1.4	747	2.63	3254	7677
5	97	460	12.35	5681	774.9	1.9	118	194.70	7.28	1418	2.9	747	2.63	9702	16801
6	97	557	13.59	7568	776.4	2.9	118	312.70	9.23	2886	4.4	747	2.6	18132	28587

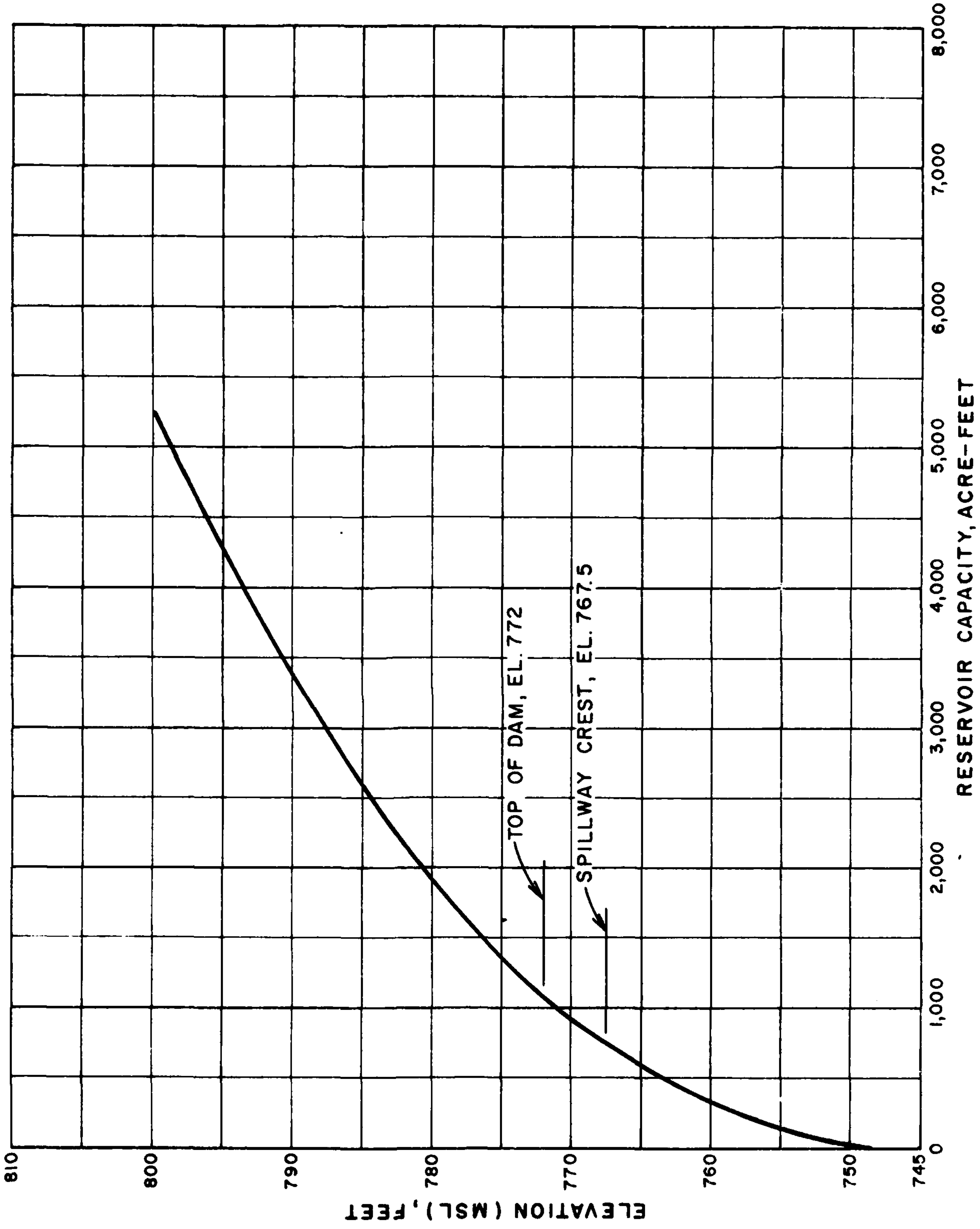
PLATE 2



SPRING LAKE DAM (MO. 10136)
SPILLWAY & OVERTOP RATING CURVE

SPRING LAKE DAM 10136
RESERVOIR AREA CAPACITY

ELEVATION M.S.L. (FT.)	RESERVOIR SURFACE AREA (ACRES)	INCREMENTAL VOLUME (Ac.Ft)	TOTAL VOLUME (Ac.FT)	REMARKS
740	0	–	0	ESTIMATED STREAMBED ELEVATION
750	14	9	9	
760	45.8	284	293	
767.5	70.5	433	726	SPILLWAY CREST
770	80	188	914	
772	84	164	1078	TOP OF DAM (assumed)
780	121.8	819	1897	
800	213.4	3309	5206	



SPRING LAKE DAM (MO. 10136)
RESERVOIR CAPACITY CURVE

ECI-4 ENGINEERING CONSULTANTS, INC.

Dam Safety Inspection — SHEET NO. 1 OF ___

Missouri Dam # 10136 — JOB NO. 1245-001-1

Probable Maximum Precipitation — BY PRW / ALB — DATE 8-17-7?

Dam # Mo. 10136

DETERMINATION OF PMP

1) DETERMINE DRAINAGE AREA OF BASIN
D.A. = 1846 Ac

2) DETERMINE PMP INDEX RAINFALL
(200 SQ MI, 24 HR DURATION)

LOCATION OF CENTROID OF BASIN

LONG 92°39'29"
LAT. 40°06'47"

PMP INDEX RAINFALL = 24.1"

3) DETERMINE BASIN RAINFALL IN TERMS OF PERCENTAGE OF PMP INDEX RAINFALL FOR VARIOUS DURATIONS.

LOCATION LONG 92°39'29"
LAT 40°06'47

⇒ ZONE 7

DURATION (HRS)	PERCENT OF INDEX RAINFALL	TOTAL RAINFALL (IN)	RAINFALL INCREMENTS	DURATION OF INCREMENTS
6	100	24.1	24.1	6
12	120	28.9	4.8	6
24	130	31.3	2.4	12

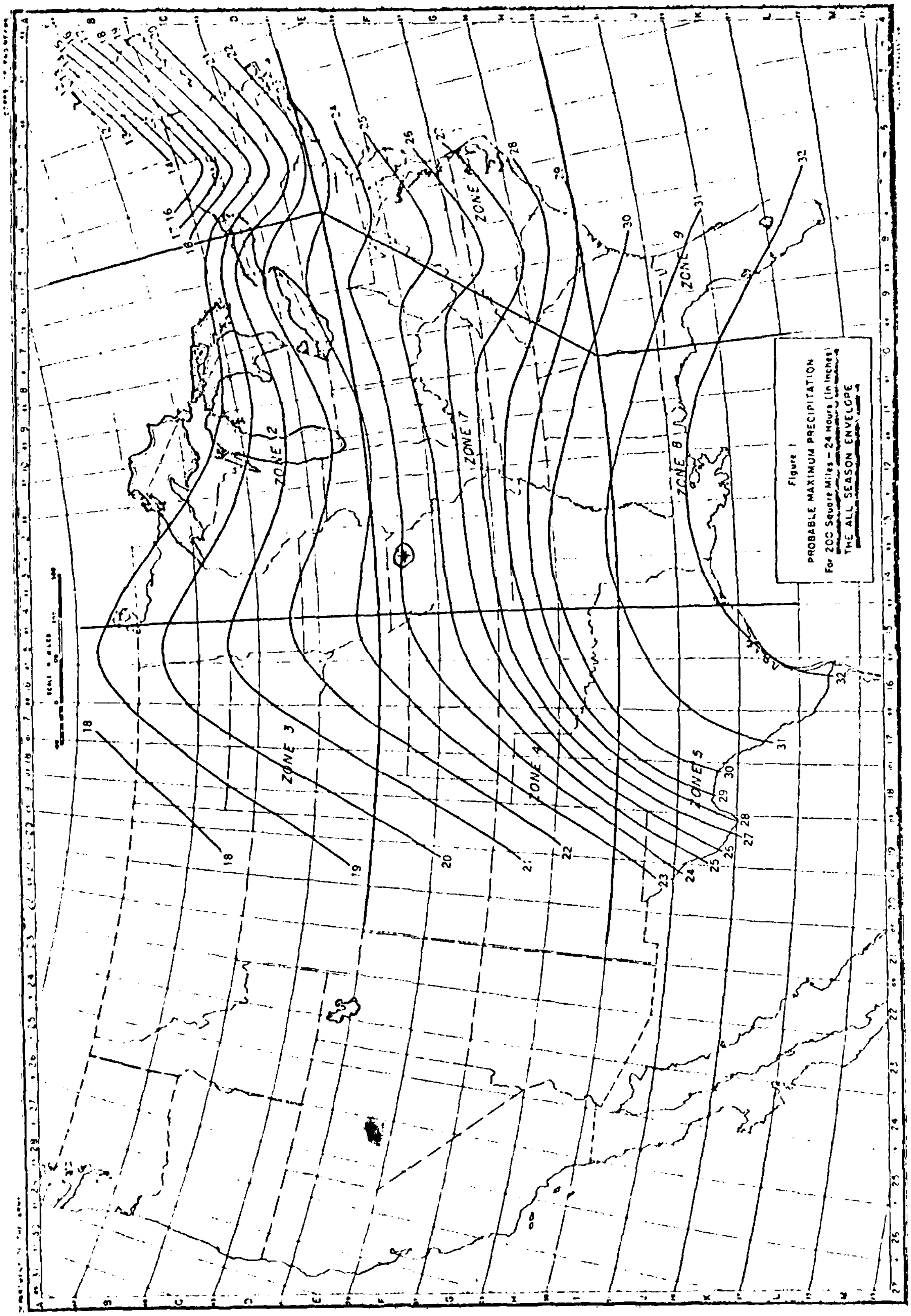
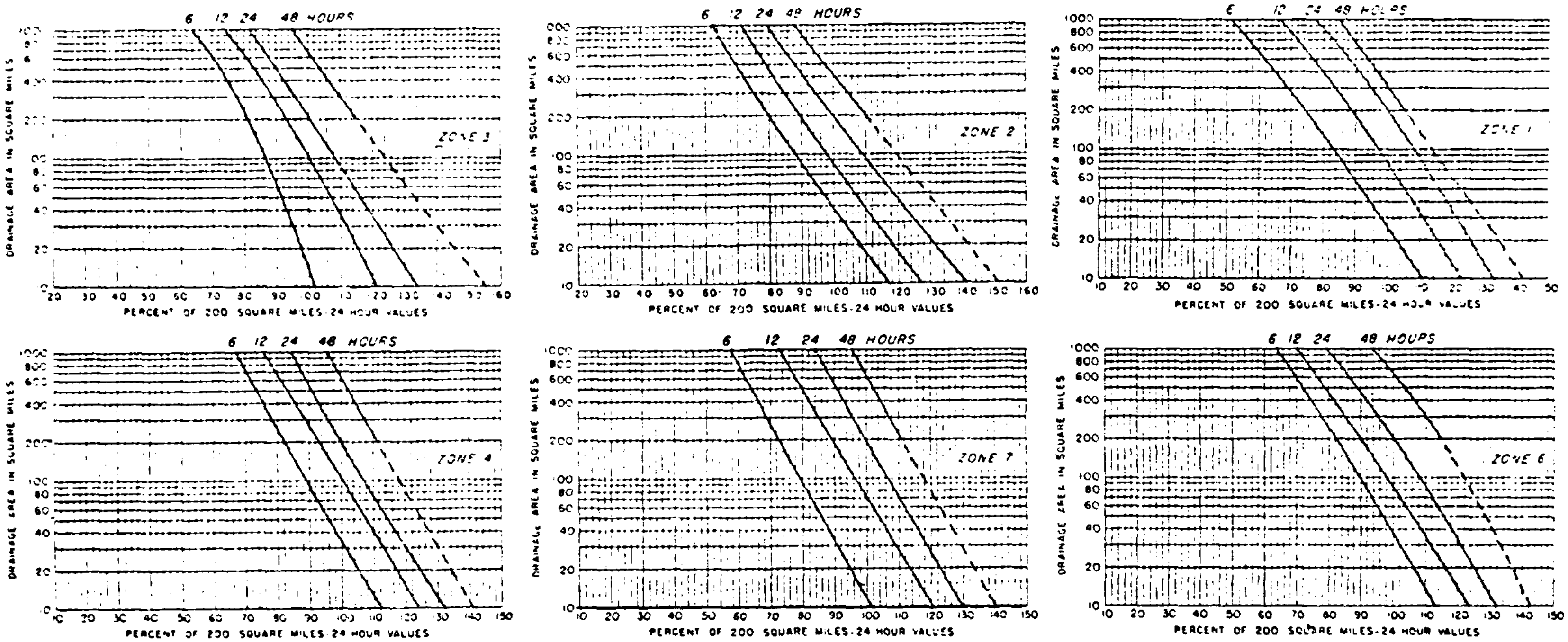


Figure 1
PROBABLE MAXIMUM PRECIPITATION
For 200 Square Miles – 24 Hours (In Inches)
THE ALL SEASON ENVELOPE



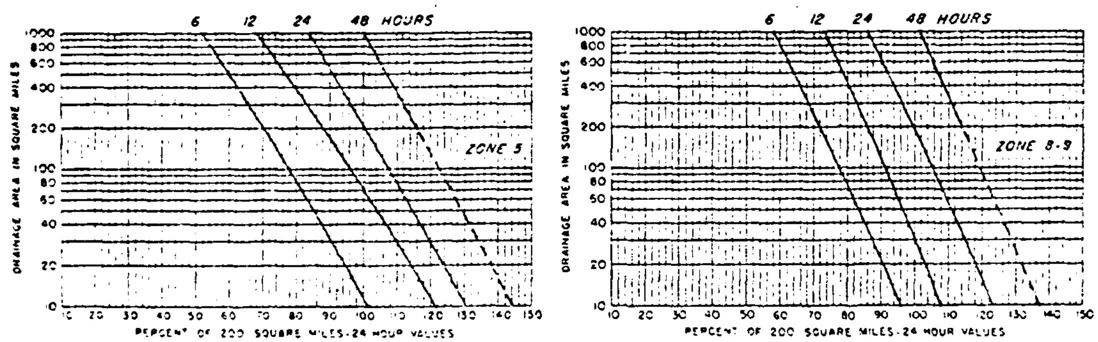


FIGURE 2

SEASONAL VARIATION

DEPTH-AREA-DURATION RELATIONSHIPS

Percentage to be applied to 200 square miles 24 hour probable maximum precipitation values for: THE-ALL SEASON ENVELOPE

ECI-4 **PRC ENGINEERING CONSULTANTS, INC.**

DAM SAFETY INSPECTION / MISSOURI SHEET NO. 1 OF
SPRING LAKE DAM (10136) JOB NO. 1240-001
UNIT HYDROGRAPH PARAMETERS BY RHK DATE 9-6-79

1) DRAINAGE AREA = 1846 AC = 2.88 SQ. MI

2) LENGTH OF STREAM = $L = (2.2 \times \frac{62500}{12}) = 11458$ Ft $= 2.17$ mi

3) ELEVATION OF DRAINAGE DIVIDE ALONG THE LONGEST STREAM $H_1 = 970$ Ft

4) RESERVOIR ELEVATION AT SPILLWAY CREST, $H_2 = 767.5$ Ft

5) DIFFERENCE IN ELEVATION $= \Delta H = H_1 - H_2 = 970 - 767.5 = 202.5$ Ft

6) SLOPE OF STREAM $= \frac{H_{85} - H_{15}}{.75L} = \frac{960-770}{.75 \times 11458} = 0.0221$
$= 2.21\%$

7) TIME OF CONCENTRATION:

a) By KIRPICH FORMULA

$$T_c = \left(\frac{11.9 \times L^3}{\Delta H}\right)^{0.385} = \left(\frac{11.9 \times (2.17)^3}{202.5}\right)^{0.385} = 0.82 \text{ hr.}$$

b) BY VELOCITY ESTIMATE:

Slope of Stream = $2.21\% \Rightarrow V = 3$ FPS

$T_c = \frac{L}{V} = \frac{11458}{3 \times 3600} = 1.06$ HR, USE $T_c = 0.82$ HR

8) LAG TIME $= 0.6 \times T_c = 0.6 \times 0.82 = 0.49$ HR

9) UNIT DURATION $D \leq \frac{L_t}{4} = \frac{0.49}{4} = 0.123$

USE $D = 0.083$ HR $= 5$ MIN

10) TIME TO PEAK, $T_p = \frac{D}{2} + L_t = 0.53$

11) PEAK DISCHARGE $q_p = \frac{484 \times A}{T_p} = \frac{484 \times 2.88}{0.53}$

$q_p = 2630$ CFS

ECI-4 **PRC ENGINEERING CONSULTANTS, INC.**

DAM SAFETY INSPECTION- MISSOURI SHEET NO. 1 OF

SPRING LAKE DAM (10136) JOB NO. 1240-001.1

SOIL GROUP AND CURVE NUMBER DETERMINATION BY KLB DATE 8-21-

SPRING LAKE DAM (10136)

HYDROLOGIC SOIL GROUP AND CURVE NUMBER

1. WATERSHED SOILS IN THIS BASIN CONSIST OF GROUP B, C, AND D SOILS. ASSUME GROUP C FOR HYDROLOGIC PURPOSES FOR THE ENTIRE WATERSHED.

2. THIS WATERSHED IS PRIMARILY FORESTED WITH ABOUT 20% IN RANGE AND PASTURE LAND. ASSUME THE HYDROLOGIC CONDITION OF THIS WATERSHED IS "FAIR".

THUS CN = 73 (WOODS) 80%

CN = 79 (PASTURE & RANGE) 20%

FOR A WEIGHTED AVERAGE

CN = 74 WITH AMC II

⇒ CN = 88 WITH AMC III

ECI-4 **PRC ENGINEERING CONSULTANTS, INC.**

DAM SAFETY INSPECTION - MISSOURI SHEET NO. 1 OF

MISSOURI DAM 10136 JOB NO. 1240-001-1

100 YEAR FLOOD BY REGRESSION EQUATION BY RHK DATE
HLBV

MISSOURI DAM 10136

100 YEAR FLOOD BY REGRESSION EQUATION

REGRESSION EQUATION FOR THE 100 YEAR FLOOD FOR MISSOURI

$$Q_{100} = 85.1\,A^{0.934A^{-0.02}}\,S^{0.576}$$

WHERE:

A = DRAINAGE AREA Sq. Mi.

S = MAIN CHANNEL SLOPE ft/mi
(AVG. SLOPE BETWEEN 0.1L AND 0.85L)

FOR MISSOURI DAM 10136

A = 2.88 Sq. Mi.

S = 117 ft./mi.

$$Q_{100} = 85.1\,(2.88)^{0.934(2.88)^{-0.02}}\,(117.0)^{0.576}$$

$$= \underline{3478} \text{ CFS}$$

HEC1DB INPUT DATA

```
******************************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION          JULY 1978
LAST MODIFICATION   26 FEB 79
******************************************

A1                   DAM SAFETY INSPECTION - MISSOURI
A2                    SPRING LAKE DAM (MO.10136)
A3                     PMF AND 50 PERCENT PMF
B     300       0       5       0       0       0       0       0
B1      5
J       1       2       1
J1      1      .5
K       0   10136                                       1
K1   INPUT PRECIPITATION VALUES, RATIOS AND UNIT HYDROGRAPH PARAMETERS
M       1       2    2.50            2.88       1                       1
P            24.1     100     120     130
T                                                      -1     -80
W2           0.43
K       0       0       1
K       1   10136                                       1
K1   ROUTE HYDROGRAPH THROUGH SPRING LAKE DAM
Y                               1       1
Y1      1                                          -767.5      -1
Y4  767.5  768.99  770.40  771.35     772   773.4   774.9   776.4
Y5      0     496    1411    2698    2650    7677   15901   29587
$A      0       3     293     725     914    1078    1897    5206
$E    748     750     760   767.5     770     772     780     805
$$  767.5
$D    772
K      99
```

B-14

INFLOW PMF AND ONE-HALF PMF HYDROGRAPHS

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT 10136
ROUTE HYDROGRAPH TO 10136
END OF NETWORK

```
*************************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
 LAST MODIFICATION  26 FEB 79
*************************************

RUN DATE* 80/01/08.
    TIME* 07.29.37.

                         DAM SAFETY INSPECTION - MISSOURI
                          SPRING LAKE DAM (MO.1174)
                           PMF AND 50 PERCENT PMF

                                JOB SPECIFICATION
          NO     NHR    NMIN    IDAY    IHR    IMIN   METRC    IPLT   IPRT  NSTAN
         300       0       5       0      0       0       0       0      0      0
                                 JOPER    NWT   LROPT   TRACE
                                     5      0       0       0

                      MULTI-PLAN ANALYSES TO BE PERFORMED
                        NPLAN= 1 NRTIO= 2 LRTIO= 1
        RTIOS=   1.00     .50

**********       **********       **********       **********       **********

                        SUB-AREA RUNOFF COMPUTATION

      INPUT PRECIPITATION VALUES, RATIOS AND UNIT HYDROGRAPH PARAMETERS

              ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
              10100       0       0       0       0       0       1       0       0

                              HYDROGRAPH DATA
      IHYDG   IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO  ISNOW   ISAME   LOCAL
          1      2    2.88    0.00    2.88    1.00   0.000      0       1       0

                                 PRECIP DATA
          SPFE     PMS      R6     R12     R24     R48     R72     R96
          0.00   24.10  100.00  120.00  130.00    0.00    0.00    0.00

                                  LOSS DATA
  LROPT  STRKR  DLTKR  RTIOL  ERAIN  STRKS  RTIOK  STRTL  CNSTL  ALSMX  RTIMP
      0   0.00   0.00   1.00   0.00   0.00   1.00  -1.00 -88.00   0.00   0.00

      CURVE NO =  -88.00  WETNESS =  -1.00  EFFECT CN =  88.00

                            UNIT HYDROGRAPH DATA
                         TC=  0.00     LAG=   .49

                              RECESSION DATA
              STRTQ=    0.00    QRCSN=   0.00    RTIOR= 1.00

     UNIT HYDROGRAPH 31 END OF PERIOD ORDINATES, TC=   0.00 HOURS, LAG=   .49  VOL= 1.00
    187.     528.    1104.    1839.    2385.    2509.    2530.    2333.    2012.    1567.
   1157.     893.     676.     547.     423.     328.     254.     195.     150.     117.
```

B-17

91. 71. 55. 42. 33. 26. 21. 17. 12. 8.

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	0.00	.01	0.	1.01	12.35	151	.20	.20	.01	[illegible]
1.01	.10	2	.01	0.00	.01	0.	1.01	12.40	152	.20	.20	.01	3193.
1.01	.15	3	.01	0.00	.01	0.	1.01	12.45	153	.20	.20	.01	3457.
1.01	.20	4	.01	0.00	.01	0.	1.01	12.50	154	.20	.20	.00	3664.
1.01	.25	5	.01	0.00	.01	0.	1.01	12.55	155	.20	.20	.00	3819.
1.01	.30	6	.01	0.00	.01	0.	1.01	13.00	156	.20	.20	.00	3940.
1.01	.35	7	.01	0.00	.01	0.	1.01	13.05	157	.24	.24	.01	4043.
1.01	.40	8	.01	0.00	.01	0.	1.01	13.10	158	.24	.24	.00	4140.
1.01	.45	9	.01	0.00	.01	0.	1.01	13.15	159	.24	.24	.00	4244.
1.01	.50	10	.01	0.00	.01	0.	1.01	13.20	160	.24	.24	.00	4364.
1.01	.55	11	.01	0.00	.01	0.	1.01	13.25	161	.24	.24	.00	4475.
1.01	1.00	12	.01	0.00	.01	0.	1.01	13.30	162	.24	.24	.00	4626.
1.01	1.05	13	.01	0.00	.01	0.	1.01	13.35	163	.24	.24	.00	4754.
1.01	1.10	14	.01	0.00	.01	0.	1.01	13.40	164	.24	.24	.00	4866.
1.01	1.15	15	.01	0.00	.01	0.	1.01	13.45	165	.24	.24	.00	4962.
1.01	1.20	16	.01	0.00	.01	0.	1.01	13.50	166	.24	.24	.00	5037.
1.01	1.25	17	.01	0.00	.01	0.	1.01	13.55	167	.24	.24	.00	5094.
1.01	1.30	18	.01	0.00	.01	0.	1.01	14.00	168	.24	.24	.00	5139.
1.01	1.35	19	.01	0.00	.01	0.	1.01	14.05	169	.30	.30	.00	5186.
1.01	1.40	20	.01	0.00	.01	0.	1.01	14.10	170	.30	.30	.00	5247.
1.01	1.45	21	.01	.00	.01	0.	1.01	14.15	171	.30	.30	.00	5336.
1.01	1.50	22	.01	.00	.01	0.	1.01	14.20	172	.30	.30	.00	5464.
1.01	1.55	23	.01	.00	.01	0.	1.01	14.25	173	.30	.30	.00	5621.
1.01	2.00	24	.01	.00	.01	1.	1.01	14.30	174	.30	.30	.00	5788.
1.01	2.05	25	.01	.00	.01	2.	1.01	14.35	175	.30	.30	.00	5952.
1.01	2.10	26	.01	.00	.01	3.	1.01	14.40	176	.30	.30	.00	6099.
1.01	2.15	27	.01	.00	.01	6.	1.01	14.45	177	.30	.30	.00	6225.
1.01	2.20	28	.01	.00	.01	9.	1.01	14.50	178	.30	.30	.00	6324.
1.01	2.25	29	.01	.00	.01	12.	1.01	14.55	179	.30	.30	.00	6399.
1.01	2.30	30	.01	.00	.01	16.	1.01	15.00	180	.30	.30	.00	6457.
1.01	2.35	31	.01	.00	.01	20.	1.01	15.05	181	.18	.18	.00	6481.
1.01	2.40	32	.01	.00	.01	24.	1.01	15.10	182	.37	.36	.00	6467.
1.01	2.45	33	.01	.00	.01	28.	1.01	15.15	183	.37	.36	.00	6484.
1.01	2.50	34	.01	.00	.01	33.	1.01	15.20	184	.55	.55	.00	6525.
1.01	2.55	35	.01	.00	.01	37.	1.01	15.25	185	.64	.64	.00	6713.
1.01	3.00	36	.01	.00	.01	41.	1.01	15.30	186	1.56	1.55	.01	7272.
1.01	3.05	37	.01	.00	.01	46.	1.01	15.35	187	2.36	2.35	.01	8562.
1.01	3.10	38	.01	.00	.01	50.	1.01	15.40	188	1.11	1.10	.00	10636.
1.01	3.15	39	.01	.00	.01	54.	1.01	15.45	189	.64	.64	.00	13435.
1.01	3.20	40	.01	.00	.01	58.	1.01	15.50	190	.55	.55	.00	16397.
1.01	3.25	41	.01	.00	.01	63.	1.01	15.55	191	.37	.37	.00	18642.
1.01	3.30	42	.01	.00	.01	67.	1.01	16.00	192	.37	.37	.00	19737.
1.01	3.35	43	.01	.00	.01	70.	1.01	16.05	193	.28	.28	.00	19734.
1.01	3.40	44	.01	.00	.01	74.	1.01	16.10	194	.28	.28	.00	18771.
1.01	3.45	45	.01	.00	.01	78.	1.01	16.15	195	.28	.28	.00	17214.
1.01	3.50	46	.01	.00	.01	82.	1.01	16.20	196	.28	.28	.00	15257.
1.01	3.55	47	.01	.00	.01	85.	1.01	16.25	197	.28	.28	.00	13379.
1.01	4.00	48	.01	.01	.01	89.	1.01	16.30	198	.28	.28	.00	11865.
1.01	4.05	49	.01	.01	.01	92.	1.01	16.35	199	.28	.28	.00	10644.
1.01	4.10	50	.01	.01	.01	95.	1.01	16.40	200	.28	.28	.00	9674.
1.01	4.15	51	.01	.01	.01	99.	1.01	16.45	201	.29	.28	.00	8903.
1.01	4.20	52	.01	.01	.01	102.	1.01	16.50	202	.28	.28	.00	8304.
1.01	4.25	53	.01	.01	.01	105.	1.01	16.55	203	.28	.28	.00	7942.
1.01	4.30	54	.01	.01	.01	108.	1.01	17.00	204	.28	.28	.00	7480.

1.01	4.35	55	.01	.01	.01	111.	1.01	17.05	205	.22	.22	.00	7190.
1.01	4.40	56	.01	.01	.01	114.	1.01	17.10	206	.22	.22	.00	6995.
1.01	4.45	57	.01	.01	.01	117.	1.01	17.15	207	.22	.22	.00	6714.
1.01	4.50	58	.01	.01	.01	119.	1.01	17.20	208	.22	.22	.00	6478.
1.01	4.55	59	.01	.01	.01	122.	1.01	17.25	209	.22	.22	.00	6232.
1.01	5.00	60	.01	.01	.01	125.	1.01	17.30	210	.22	.22	.00	5999.
1.01	5.05	61	.01	.01	.01	127.	1.01	17.35	211	.22	.22	.00	5786.
1.01	5.10	62	.01	.01	.01	130.	1.01	17.40	212	.22	.22	.00	5602.
1.01	5.15	63	.01	.01	.01	132.	1.01	17.45	213	.22	.22	.00	5446.
1.01	5.20	64	.01	.01	.01	135.	1.01	17.50	214	.22	.22	.00	5321.
1.01	5.25	65	.01	.01	.01	137.	1.01	17.55	215	.22	.22	.00	5224.
1.01	5.30	66	.01	.01	.01	139.	1.01	18.00	216	.22	.22	.00	5147.
1.01	5.35	67	.01	.01	.01	142.	1.01	18.05	217	.02	.02	.00	5048.
1.01	5.40	68	.01	.01	.01	144.	1.01	18.10	218	.02	.02	.00	4892.
1.01	5.45	69	.01	.01	.01	146.	1.01	18.15	219	.02	.02	.00	4603.
1.01	5.50	70	.01	.01	.01	148.	1.01	18.20	220	.02	.02	.00	4249.
1.01	5.55	71	.01	.01	.01	150.	1.01	18.25	221	.02	.02	.00	3754.
1.01	6.00	72	.01	.01	.01	152.	1.01	18.30	222	.02	.02	.00	3220.
1.01	6.05	73	.07	.04	.03	[illegible]	1.01	18.35	223	.02	.02	.00	2692.
1.01	6.10	74	.07	.04	.03	179.	1.01	18.40	224	.02	.02	.00	2217.
1.01	6.15	75	.07	.04	.03	215.	1.01	18.45	225	.02	.02	.00	1809.
1.01	6.20	76	.07	.04	.03	274.	1.01	18.50	226	.02	.02	.00	1493.
1.01	6.25	77	.07	.04	.02	359.	1.01	18.55	227	.02	.02	.00	1255.
1.01	6.30	78	.07	.05	.02	450.	1.01	19.00	228	.02	.02	.00	1073.
1.01	6.35	79	.07	.05	.02	543.	1.01	19.05	229	.02	.02	.00	932.
1.01	6.40	80	.07	.05	.02	634.	1.01	19.10	230	.02	.02	.00	821.
1.01	6.45	81	.07	.05	.02	716.	1.01	19.15	231	.02	.02	.00	735.
1.01	6.50	82	.07	.05	.02	[illegible]	1.01	19.20	232	.02	.02	.00	668.
1.01	6.55	83	.07	.05	.02	845.	1.01	19.25	233	.02	.02	.00	616.
1.01	7.00	84	.07	.05	.02	895.	1.01	19.30	234	.02	.02	.00	577.
1.01	7.05	85	.07	.05	.01	939.	1.01	19.35	235	.02	.02	.00	546.
1.01	7.10	86	.07	.05	.01	978.	1.01	19.40	236	.02	.02	.00	523.
1.01	7.15	87	.07	.05	.01	1012.	1.01	19.45	237	.02	.02	.00	505.
1.01	7.20	88	.07	.05	.01	1042.	1.01	19.50	238	.02	.02	.00	490.
1.01	7.25	89	.07	.05	.01	1069.	1.01	19.55	239	.02	.02	.00	480.
1.01	7.30	90	.07	.05	.01	1093.	1.01	20.00	240	.02	.02	.00	471.
1.01	7.35	91	.07	.06	.01	1115.	1.01	20.05	241	.02	.02	.00	464.
1.01	7.40	92	.07	.06	.01	1135.	1.01	20.10	242	.02	.02	.00	459.
1.01	7.45	93	.07	.06	.01	1153.	1.01	20.15	243	.02	.02	.00	455.
1.01	7.50	94	.07	.06	.01	1170.	1.01	20.20	244	.02	.02	.00	452.
1.01	7.55	95	.07	.06	.01	1185.	1.01	20.25	245	.02	.02	.00	449.
1.01	8.00	96	.07	.06	.01	1200.	1.01	20.30	246	.02	.02	.00	448.
1.01	8.05	97	.07	.06	.01	1213.	1.01	20.35	247	.02	.02	.00	447.
1.01	8.10	98	.07	.06	.01	1225.	1.01	20.40	248	.02	.02	.00	447.
1.01	8.15	99	.07	.06	.01	1236.	1.01	20.45	249	.02	.02	.00	447.
1.01	8.20	100	.07	.06	.01	1247.	1.01	20.50	250	.02	.02	.00	447.
1.01	8.25	101	.07	.06	.01	1257.	1.01	20.55	251	.02	.02	.00	447.
1.01	8.30	102	.07	.06	.01	1266.	1.01	21.00	252	.02	.02	.00	447.
1.01	8.35	103	.07	.06	.01	1275.	1.01	21.05	253	.02	.02	.00	447.
1.01	8.40	104	.07	.06	.01	1283.	1.01	21.10	254	.02	.02	.00	447.
1.01	8.45	105	.07	.06	.01	1290.	1.01	21.15	255	.02	.02	.00	447.
1.01	8.50	106	.07	.06	.01	[illegible]	1.01	21.20	256	.02	.02	.00	447.
1.01	8.55	107	.07	.06	.01	1304.	1.01	21.25	257	.02	.02	.00	447.
1.01	9.00	108	.07	.06	.01	1311.	1.01	21.30	258	.02	.02	.00	447.
1.01	9.05	109	.07	.06	.01	1317.	1.01	21.35	259	.02	.02	.00	447.
1.01	9.10	110	.07	.06	.01	1323.	1.01	21.40	260	.02	.02	.00	447.
1.01	9.15	111	.07	.06	.01	1323.	1.01	21.45	261	.02	.02	.00	447.
1.01	9.20	112	.07	.06	.01	1334.	1.01	21.50	262	.02	.02	.00	447.
1.01	9.25	113	.07	.06	.01	1339.	1.01	21.55	263	.02	.02	.00	447.
1.01	9.30	114	.07	.06	.01	1343.	1.01	22.00	264	.02	.02	.00	447.

1.01	9.35	115	.07	.06	.01	1348.		1.01	22.05	265	.02	.02	.00	447.
1.01	9.40	116	.07	.06	.01	1352.		1.01	22.10	266	.02	.02	.00	447.
1.01	9.45	117	.07	.06	.00	1356.		1.01	22.15	267	.02	.02	.00	447.
1.01	9.50	118	.07	.06	.00	1360.		1.01	22.20	268	.02	.02	.00	447.
1.01	9.55	119	.07	.06	.00	1364.		1.01	22.25	269	.02	.02	.00	447.
1.01	10.00	120	.07	.06	.00	1368.		1.01	22.30	270	.02	.02	.00	447.
1.01	10.05	121	.07	.06	.00	1371.		1.01	22.35	271	.02	.02	.00	447.
1.01	10.10	122	.07	.06	.00	1375.		1.01	22.40	272	.02	.02	.00	447.
1.01	10.15	123	.07	.06	.00	1378.		1.01	22.45	273	.02	.02	.00	447.
1.01	10.20	124	.07	.06	.00	1381.		1.01	22.50	274	.02	.02	.00	447.
1.01	10.25	125	.07	.06	.00	1384.		1.01	22.55	275	.02	.02	.00	447.
1.01	10.30	126	.07	.06	.00	1387.		1.01	23.00	276	.02	.02	.00	447.
1.01	10.35	127	.07	.06	.00	1389.		1.01	23.05	277	.02	.02	.00	447.
1.01	10.40	128	.07	.06	.00	1392.		1.01	23.10	278	.02	.02	.00	447.
1.01	10.45	129	.07	.06	.00	1394.		1.01	23.15	279	.02	.02	.00	447.
1.01	10.50	130	.07	.06	.00	1397.		1.01	23.20	280	.02	.02	.00	447.
1.01	10.55	131	.07	.06	.00	1399.		1.01	23.25	281	.02	.02	.00	447.
1.01	11.00	132	.07	.06	.00	1401.		1.01	23.30	282	.02	.02	.00	447.
1.01	11.05	133	.07	.06	.00	1404.		1.01	23.35	283	.02	.02	.00	447.
1.01	11.10	134	.07	.06	.00	1406.		1.01	23.40	284	.02	.02	.00	447.
1.01	11.15	135	.07	.06	.00	1408.		1.01	23.45	285	.02	.02	.00	447.
1.01	11.20	136	.07	.06	.00	1410.		1.01	23.50	286	.02	.02	.00	447.
1.01	11.25	137	.07	.06	.00	1412.		1.01	23.55	287	.02	.02	.00	447.
1.01	11.30	138	.07	.06	.00	1413.		1.02	0.00	288	.02	.02	.00	447.
1.01	11.35	139	.07	.06	.00	1415.		1.02	.05	289	0.00	0.00	0.00	443.
1.01	11.40	140	.07	.06	.00	1417.		1.02	.10	290	0.00	0.00	0.00	432.
1.01	11.45	141	.07	.06	.00	1419.		1.02	.15	291	0.00	0.00	0.00	410.
1.01	11.50	142	.07	.06	.00	1420.		1.02	.20	292	0.00	0.00	0.00	373.
1.01	11.55	143	.07	.06	.00	1422.		1.02	.25	293	0.00	0.00	0.00	326.
1.01	12.00	144	.07	.06	.00	1423.		1.02	.30	294	0.00	0.00	0.00	274.
1.01	12.05	145	.20	.19	.01	1448.		1.02	.35	295	0.00	0.00	0.00	222.
1.01	12.10	146	.20	.19	.01	1513.		1.02	.40	296	0.00	0.00	0.00	175.
1.01	12.15	147	.20	.19	.01	1663.		1.02	.45	297	0.00	0.00	0.00	134.
1.01	12.20	148	.20	.19	.01	1902.		1.02	.50	298	0.00	0.00	0.00	103.
1.01	12.25	149	.20	.19	.01	2211.		1.02	.55	299	0.00	0.00	0.00	90.
1.01	12.30	150	.20	.19	.01	2550.		1.02	1.00	300	0.00	0.00	0.00	62.
										SUM	31.33	29.75	1.58	662989.
											(796.)	(756.)	(40.)	(18773.76)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	19737.	7236.	2302.	2210.	662951.
CMS	559.	205.	65.	63.	18773.
INCHES		23.37	29.74	29.74	29.74
MM		593.69	755.41	755.41	755.41
AC-FT		3598.	4566.	4566.	4566.
THOUS CU M		4426.	5632.	5632.	5632.

HYDROGRAPH AT STA 10136 FOR PLAN 1, RTIO 1

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	1.	2.	3.	6.	9.	12.	15.
20.	24.	28.	33.	37.	41.	46.	50.	54.	58.
63.	67.	70.	74.	78.	82.	85.	89.	92.	95.
99.	102.	105.	108.	111.	114.	117.	119.	122.	125.
127.	130.	132.	135.	137.	139.	142.	144.	147.	149.
150.	152.	160.	177.	216.	279.	359.	450.	544.	639.
716.	786.	845.	895.	939.	978.	1012.	1042.	1067.	1093.

1115.	1135.	1155.	1170.	1185.	1200.	1213.	1225.	1236.	1247.
1257.	1265.	1275.	1283.	1290.	1298.	1304.	1311.	1317.	1323.
1328.	1334.	1339.	1343.	1348.	1352.	1356.	1360.	1364.	1368.
1371.	1375.	[illegible]	1381.	1384.	1387.	1389.	1392.	1394.	1397.
1399.	1401.	1404.	1406.	1408.	1410.	1412.	1413.	1415.	1417.
[illegible]	1420.	1422.	1423.	1448.	1519.	1663.	1908.	2211.	2550.
2897.	3193.	3457.	3664.	3819.	3940.	4043.	4140.	4244.	4364.
4495.	4628.	4759.	4866.	[illegible]	5037.	5094.	5139.	5195.	5247.
5335.	5464.	5621.	5788.	5952.	6094.	6225.	6324.	6379.	6457.
6491.	6487.	6494.	6525.	6713.	7272.	8562.	10636.	13493.	16997.
15642.	19737.	19734.	18771.	17214.	15257.	13379.	11865.	10644.	9674.
8903.	8304.	7842.	7480.	7190.	6945.	6714.	6475.	6232.	5999.
5786.	5612.	5445.	5321.	5224.	5147.	5049.	4892.	4641.	4248.
3759.	3220.	2692.	2217.	1809.	1490.	1255.	1073.	932.	821.
[illegible]	668.	616.	577.	546.	523.	505.	490.	480.	471.
464.	459.	455.	452.	449.	448.	447.	447.	447.	447.
447.	447.	447.	447.	447.	447.	447.	447.	447.	447.
447.	447.	447.	447.	447.	447.	447.	447.	447.	447.
447.	447.	447.	447.	447.	447.	447.	447.	447.	447.
447.	447.	447.	447.	447.	447.	447.	447.	443.	432.
410.	373.	326.	274.	222.	175.	134.	103.	[illegible]	62.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	19737.	7236.	2302.	2210.	662951.
CMS	559.	205.	65.	63.	19773.
INCHES		23.37	29.74	29.74	29.74
MM		593.68	755.41	755.41	755.41
AC-FT		3589.	4566.	4566.	4566.
THOUS CU M		4426.	5632.	5632.	5632.

HYDROGRAPH AT STA 10136 FOR PLAN 1, RTIO 2

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.	2.	3.	4.	6.	8.
10.	12.	14.	16.	19.	21.	23.	25.	27.	29.
31.	33.	35.	37.	39.	41.	43.	44.	45.	46.
49.	51.	53.	54.	55.	57.	58.	60.	61.	62.
64.	65.	66.	67.	69.	70.	71.	72.	73.	74.
75.	76.	80.	89.	105.	139.	179.	225.	272.	317.
359.	393.	422.	447.	469.	489.	506.	521.	535.	547.
554.	568.	577.	585.	593.	600.	606.	612.	618.	623.
628.	633.	637.	641.	645.	649.	652.	655.	658.	661.
664.	667.	669.	672.	674.	676.	678.	680.	682.	684.
686.	687.	689.	690.	692.	693.	695.	696.	697.	699.
700.	701.	702.	703.	704.	705.	706.	707.	708.	708.
709.	710.	711.	712.	724.	759.	871.	951.	1106.	1275.
1444.	1596.	1728.	1832.	1910.	1970.	2021.	2070.	2122.	2132.
2248.	2314.	2377.	2433.	2481.	2519.	2547.	2570.	2593.	2623.
2668.	2732.	2810.	2894.	2973.	3049.	3117.	3162.	3199.	3229.
3249.	3244.	3242.	3263.	3356.	3656.	4281.	5318.	6707.	8199.
9321.	9868.	9867.	9385.	8607.	7626.	6693.	5933.	5322.	4837.
4451.	4152.	3921.	3741.	3535.	3473.	3357.	3237.	3114.	3000.
2893.	2801.	2723.	2663.	2610.	2574.	2524.	2446.	2320.	2124.
1977.	1610.	1346.	1109.	904.	745.	627.	537.	456.	410.
357.	339.	30[illegible]	28[illegible]	277.	261.	252.	245.	240.	289.
232.	230.	227.	227.	225.	224.	223.	223.	223.	223.
223.	223.	223.	227.	223.	223.	223.	223.	223.	223.
223.	223.	223.	223.	223.	223.	223.	223.	223.	223.

223.	223.	223.	223.	223.	223.	223.	223.	223.	223.
223.	223.	223.	223.	223.	223.	223.	223.	222.	216.
205.	187.	16[illegible].	137.	111.	87.	67.	52.	40.	31.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	9868.	3618.	1151.	1105.	331475.
CMS	279.	102.	33.	31.	9386.
INCHES		11.69	14.87	14.87	14.87
MM		296.84	377.70	377.70	377.70
AC-FT		1794.	2283.	2283.	2283.
THOUS CU M		2213.	2816.	2816.	2816.

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HYDROGRAPH ROUTING

ROUTE HYDROGRAPH THROUGH SPRING LAKE DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
10136	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.000	0.00	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-768.	-1

STAGE	767.50	768.99	770.48	771.95	772.00	773.40	774.90	776.40
FLOW	0.00	493.00	1411.00	2608.00	2655.00	7677.00	16801.00	28587.00

CAPACITY=	0.	3.	293.	726.	914.	107[illegible].	1397.	5206.
ELEVATION=	748.	750.	753.	759.	770.	772.	780.	800.

CREL	SPWID	COQW	EXPW	ELEVL	COOL	CAREA	EXPL
747.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
772.0	0.0	0.0	0.

STATION 10136, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	1.	1.
2.	2.	3.	4.	5.	6.	7.	9.	[illegible]	11.
12.	14.	1[illegible].	17.	19.	21.	23.	25.	27.	29.
31.	33.	35.	37.	39.	41.	44.	46.	48.	50.
53.	55.	57.	50.	62.	64.	66.	69.	71.	73.
76.	78.	80.	85.	8[illegible].	91.	98.	107.	119.	133.
14[illegible].	167.	187.	207.	229.	231.	273.	296.	318.	341.

SUMMARY OF PMF AND ONE-HALF PMF FLOOD ROUTING

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

RATIOS APPLIED TO FLOWS

OPERATION	STATION	AREA	PLAN	RATIO 1 1.00	RATIO 2 .50
HYDROGRAPH AT	10136	2.88	1	19737.	9868.
		(7.46)		(558.88)(	279.44)(
ROUTED TO	10136	2.88	1	17866.	8169.
		(7.46)		(505.90)(	231.32)(

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SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	767.50	767.50	772.00
STORAGE	726.	726.	1074.
OUTFLOW	0.	0.	2650.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	775.34	3.34	1389.	17866.	5.58	15.25	0.00
.50	773.49	1.49	1230.	8169.	2.33	16.25	0.00

PERCENT OF PMF FLOOD ROUTING
EQUAL TO SPILLWAY CAPACITY

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

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RUNOFF HYDROGRAPH AT      10136
ROUTE HYDROGRAPH TO       10136
END OF NETWORK
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*************************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  26 FEB 79
*************************************

RUN  DATE* 80/01/08.
     TIME* 07.28.02.

                    DAM SAFETY INSPECTION - MISSOURI
                     SPRING LAKE DAM (MO.10136)
                           PERCENT PMF

                           JOB SPECIFICATION
     NQ      NHR     NMIN    IDAY     IHR     IMIN    METRC    IPLT    IPRT    NSTAN
    300        0        0       0       0        0        0       0       4        0
                            JOPER     NWT    LROPT    TRACE
                                5       0        0        0

                    MULTI-PLAN ANALYSES TO BE PERFORMED
                      NPLAN= 1 NRTIO= 5 LRTIO= 1
          RTIOS=     .20     .21     .22     .23     .24     .25

   **********     **********     **********     **********     **********

                       SUB-AREA RUNOFF COMPUTATION

     INPUT PRECIPITATION VALUES, RATIOS AND UNIT HYDROGRAPH PARAMETERS

           ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
           10136       0       0       0       0       0       1       0

                           HYDROGRAPH DATA
     IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
         1       2    2.68    0.00    2.68    1.00   0.000       0       1

                             PRECIP DATA
          SPFE     PMS      R6     R12     R24     R48     R72     R96
          0.00   24.10  100.00  120.00  130.00    0.00    0.00    0.00

                              LOSS DATA
 LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
          0.00    0.00    1.00    0.00    0.00    1.00   -1.00  -86.00    0.00    0.00

       CURVE NO = -86.00  WETNESS =   -1.00  EFFECT CN =   86.00

                          UNIT HYDROGRAPH DATA
                        TC=  0.00   LAG=   .43

                             RECESSION DATA
                STRTQ=    .00     QRCSN=    0.00    RTIOR= 1.00

                          END-OF-PERIOD FLOW
 MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS   COMP Q     MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS   COMP Q
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                                                                              S14  31.43  79.78   4.7F   682449.
                                                                                 ( )  .11 78(.11   ( .(1107)),761

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                                         HYDROGRAPH ROUTING

                   ROUTE HYDROGRAPH THROUGH SPRING LAKE DAM

                              ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT    INAME  ISTAGE   IAUTO
                              10126       1       0               0               1               0
                                                    ROUTING DATA
                       QLOSS   CLOSS    AVG    IRES   ISAME    IOPT    IPMP            LSTR
                         0.0   0.000   0.00       1       1               0               0

                              NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                                  1       0       0   0.000   0.000   0.000   -765.     -1

   STAGE      767.50    768.09    770.43    771.33    772.0     777.40    774.30    770.40

   FLOW         0.00    495.00   1511.00   2608.00   2650.00   7677.00   16P 1.00  20587.00

     CAPACITY=       0.        0.      243.      72 .      914.     137 .    1697.     2205.

     ELEVATION=    748.      750.      760.      768.      770.      772.      780.        .

                           CREL   SPWID    COQW    EXPW   ELEVL    COQL   CAREA    EXPL
                          767.5     0.0     0.0     0.0     0.0     0.0     0.0     0.0

                                                 DAM DATA
                                         TOPEL    COQD    EXPD   DAMWID
                                         772.0     0.0     0.0      0.

   PEAK OUTFLOW IS    2198. AT TIME  16.58 HOURS

   PEAK OUTFLOW IS    2217. AT TIME  16.58 HOURS

   PEAK OUTFLOW IS    2336. AT TIME  16.58 HOURS

   PEAK OUTFLOW IS    2454. AT TIME  16.58 HOURS

   PEAK OUTFLOW IS    2572. AT TIME  16.53 HOURS

   PEAK OUTFLOW IS    2749. AT TIME  16.58 HOURS

          **********          **********          **********          **********          **********
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PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

RATIOS APPLIED TO FLOWS

OPERATION	STATION	AREA	PLAN	RATIO 1 .20	RATIO 2 .21	RATIO 3 .22	RATIO 4 .23	RATIO 5 .24	RATIO 6 .25
HYDROGRAPH AT	1.135	2.88	1	3947.	4145.	4340.	4539.	4737.	4934.
	(	7.46)	(	111.76)(	117.34)(	122.90)(	128.54)(	134.13)(	139.72)(
ROUTED TO	[illegible]	[illegible]	1	[illegible]	2217.	2336.	2454.	2572.	2763.
	(	[illegible])	(	57.[illegible])(	[illegible].79)(	66.15)(	69.3[illegible])(	72.83)(	78.41)(

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SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	[illegible]	[illegible]	772.00
STORAGE	[illegible]	720.	107[illegible].
OUTFLOW	0.	0.	2650.

RATIO OF PMF	MAXIMUM RESERVOIR W.S. ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	771.3[illegible]	0.00	1023.	2098.	0.00	16.59	0.00
[illegible]	[illegible]	0.00	1035.	2217.	0.00	16.58	0.00
[illegible]	771.[illegible]	0.00	1047.	2336.	0.00	16.58	0.00
.23	[illegible]	0.00	[illegible]	2454.	0.00	16.58	0.00
.24	771.91	0.00	1070.	2572.	0.00	16.58	0.00
.25	772.[illegible]	.05	[illegible]	2769.	.25	16.58	0.00

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DAT

FILM